FINAL

PHASE I RFI/RI WORK PLAN

ROCKY FLATS PLANT
100 AREA
(OPERABLE UNIT NO. 13)

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

ENVIRONMENTAL RESTORATION PROGRAM

OCTOBER, 1992
(Revised March 10, 1993)

Volume I of III
Text

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OPERABLE UNIT 13 FIGURES 6-4 THROUGH 6-10

In order to minimize multiple reiterations of expensive color copies, only black and white copies were included in this submittal. If the changed figures are acceptable to CDH and EPA, final color copies will be transmitted within seven working days.

TITLE: FSAP

Approved By:

04/01/93
Effective Date

Manager

/ /
Date

6.0 FIELD SAMPLING AND ANALYSIS PLAN

The purpose of this section of the work plan is to develop a Field Sampling and Analysis Plan (FSAP) that will address the data needs of the Phase I RFI/RI and describe the work required to fulfill the data quality objectives. Section 6.1 presents the objectives of the OU 13 RFI/RI. Section 6.2 summarizes site background information and rationale for the sampling, analysis, and other data collection activities. Section 6.3 discusses the field data collection program for each site. Section 6.4 describes field sampling procedures and equipment, and Section 6.5 describes the analytical program including sample designation, analytical requirements, sample containers and preservation, and sample handling and documentation. Section 6.6 describes QA/QC procedures for the OU 13 RFI/RI.

6.1 OU 13 RFI/RI OBJECTIVES

The objective of this FSAP is to provide environmental measurement data of sufficient detail and quality to meet the intended use of the data. The data generated through implementation of this FSAP will be used to:

- First, establish the presence or absence of contaminants;
- Second, characterize the environmental setting of each IHSS;
- Characterize the nature and extent of contamination;
- Third, assess fate and transport of contaminants;

- Assess risk to human health and environment;
- And finally, support selection of remedial action alternatives.

This FSAP is designed to identify, then characterize, contamination of soils and groundwater that may have resulted from historical releases at OU 13 IHSSs and at other potential areas of concern (PACs) within/or at locations identified where potential incidents of concern (PICs) are thought to have occurred near OU 13, as presented in the Historical Release Report (HRR) July 1992. Air, surface water, and sediment will be characterized using data collected under other sitewide programs unless additional data are determined to be required for these media (see Section 6.2.2).

6.2 BACKGROUND AND SAMPLING RATIONALE

6.2.1 Background

Available information regarding potential contamination associated with OU 13 includes limited IHSS histories, stratigraphic well logs, water level data, and analytical data for air, groundwater, surface water, sediment, surficial soils, and borehole samples collected within and around OU 13. This information is described in detail in Section 2.0 of this work plan.

As stated in Section 2.0, the available analytical data indicate the potential for contamination at or near several IHSSs but do not provide direct evidence of contamination. Nor is the data of a sufficient quantity or quality to allow a determination of the source(s) of contamination or the nature and extent of contamination. The existing data are currently being validated to the extent possible. The use of these data in making RFI/RI decisions will be continually evaluated as the validation process continues.

6.2.2 Sampling Rationale

The rationale for Phase I sampling activities is based on a staged approach (Table 6.1, Revised). Stage 1 will address the first objective to determine if contamination is present. It will involve

primarily non-invasive screening-level surveys. Stage 2 will confirm the results of Stage 1 and verify the presence of contamination in the vadose zone and/or groundwater and begin to define the nature and extent of the contamination. Stage 3, if necessary, will address the potential migration of contaminants from each IHSS. Figures 6-1A through 6-1D present sampling decision trees for each IHSS identifying investigation stages, types of sampling, and sampling decisions. Section 6.2 presents the planned sampling activities at each IHSS. Table 6.2, compares the planned sampling activities with those required by the IAG. The procedures that will be used in each type of sampling are listed in Table 6.3 and discussed in Section 6.4.

Stage 1 sampling activities are designed to detect contamination at each IHSS primarily using non-invasive screening-level surveys. These surveys will provide an assessment of the presence or absence of contamination and they will also begin to define the nature of contamination present. They will provide information on a real-time basis that is needed for planning more detailed investigations of each IHSS. The types of activities to be conducted during Stage 1 include:

- Visual inspections;
- Surface radiological surveys;
- Soil-gas surveys;
- Soil borings (limited to IHSSs 148 and 186 where underground releases of contaminants are thought to have occurred);
- Surficial soil sampling; and
- Groundwater sampling from existing wells and piezometers.

Revised Table 6.1
(sheet 1 of 3)

Phase I Investigations for OU 13

Activity	Purpose	Location	Sample Number
Stage 1			
Visual Inspection	Identify areas of visible contamination. Assess access problems.	Entire IHSS area.	None.
HPGe Radiological Survey	Identify areas of anomalous gamma ray radiation readings.	Entire IHSS area.	IHSS dependent.
Soil Gas Survey	Locate VOC anomalies.	Entire IHSS area - grid spacing IHSS dependent.	IHSS dependent
Surficial Soil Sampling	Assess radiological and nonradiological contamination. Confirm HPGe results.	Entire IHSS area - locations IHSS dependent.	IHSS dependent.
Vertical Soil Profiles	Aid interpretation of HPGe survey.	Locations selected after HPGe survey completed.	To be determined.
Soil Borings	Assess radiological and nonradiological contamination at IHSSs where subsurface contamination may be present.	IHSS dependent.	IHSS dependent.
Asphalt/Concrete Samples	Determine the presence or absence of radionuclides.	IHSS dependent.	IHSS dependent.

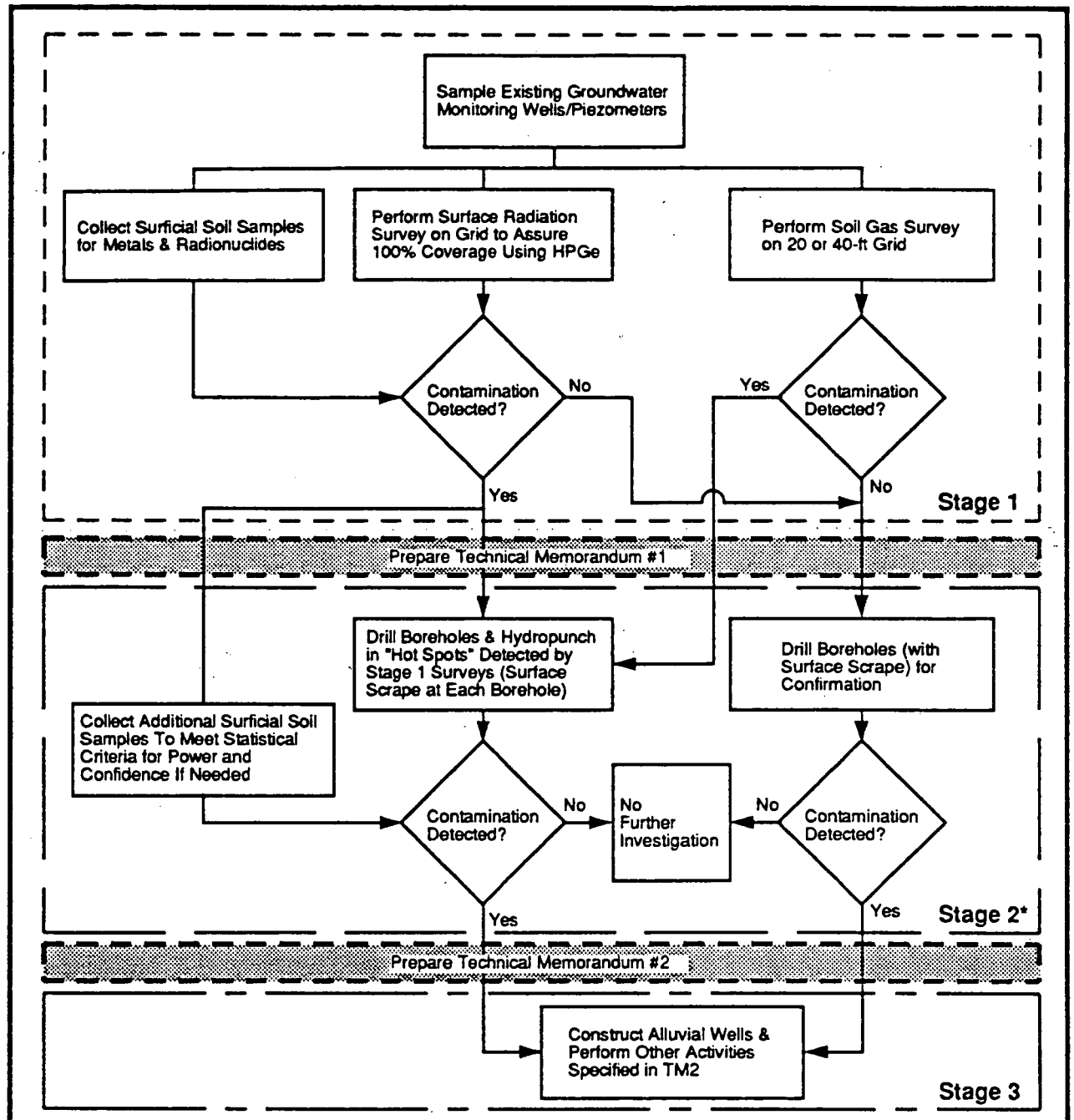
Phase I Investigations for OU 13

Activity	Purpose	Location	Sample Number
Stage 1 (continued)			
Sampling of Existing Groundwater Monitoring Wells and Piezometers	Assess radiological and nonradiological contamination. Begin characterization of groundwater conditions.	IHSS dependent.	IHSS dependent.
Sampling of Water in Sump	Assess potential contamination of surface water.	IHSS 171.	One.
TECHNICAL MEMORANDUM NO. 1			
Stage 2			
Additional Soil Samples	Provide proper statistical power and confidence if needed.		
Surface Scrapes	Determine presence/absence of contaminants at borehole locations.	IHSS dependent (at borehole locations).	To be determined.
	a. Sample anomalies identified by HPGe and soil gas surveys or confirm absence of contamination. b. Characterize subsurface vadose zone conditions and contamination.	IHSS dependent - at a minimum, one at most likely spot to be contaminated in IHSSs where no contamination was detected by screening surveys or one at the maxima detected by the HPGe and/or soil gas surveys in IHSSs where contamination was detected by screening surveys (locations to be specified in technical memorandum).	To be determined - to be specified in technical memorandum.

Revised Table 6.1
(sheet 3 of 3)

Phase I Investigations for OU 13

Activity	Purpose	Location	Sample Number
Stage 2 (continued)			
Groundwater Sampling with Hydropunch, or equivalent TECHNICAL MEMORANDUM NO. 2	Assess groundwater contamination.	IHSS dependent - at a minimum, samples to be taken in boreholes drilled at maxima detected by screening surveys (locations to be specified in technical memorandum.	To be determined - to be specified in technical memorandum.
Stage 3			
Soil Borings	Assessment of contaminants in subsurface.	To be determined - to be specified in technical memorandum.	To be determined - to be specified in technical memorandum.
Monitoring Well Installation and Sampling and/or Sampling with Hydropunch, or equivalent	Assess nature and extent of contamination of groundwater.	To be determined - to be specified in technical memorandum.	To be determined - to be specified in technical memorandum.
Tensiometer Nests or equivalent and Leachability Tests	Determine transport characteristics	To be determined - to be specified in technical memorandum.	To be determined - to be specified in technical memorandum.



***Details regarding the Stage 2 and Stage 3 investigations will be specified in Technical Memorandums 1 and 2, respectively.**

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT

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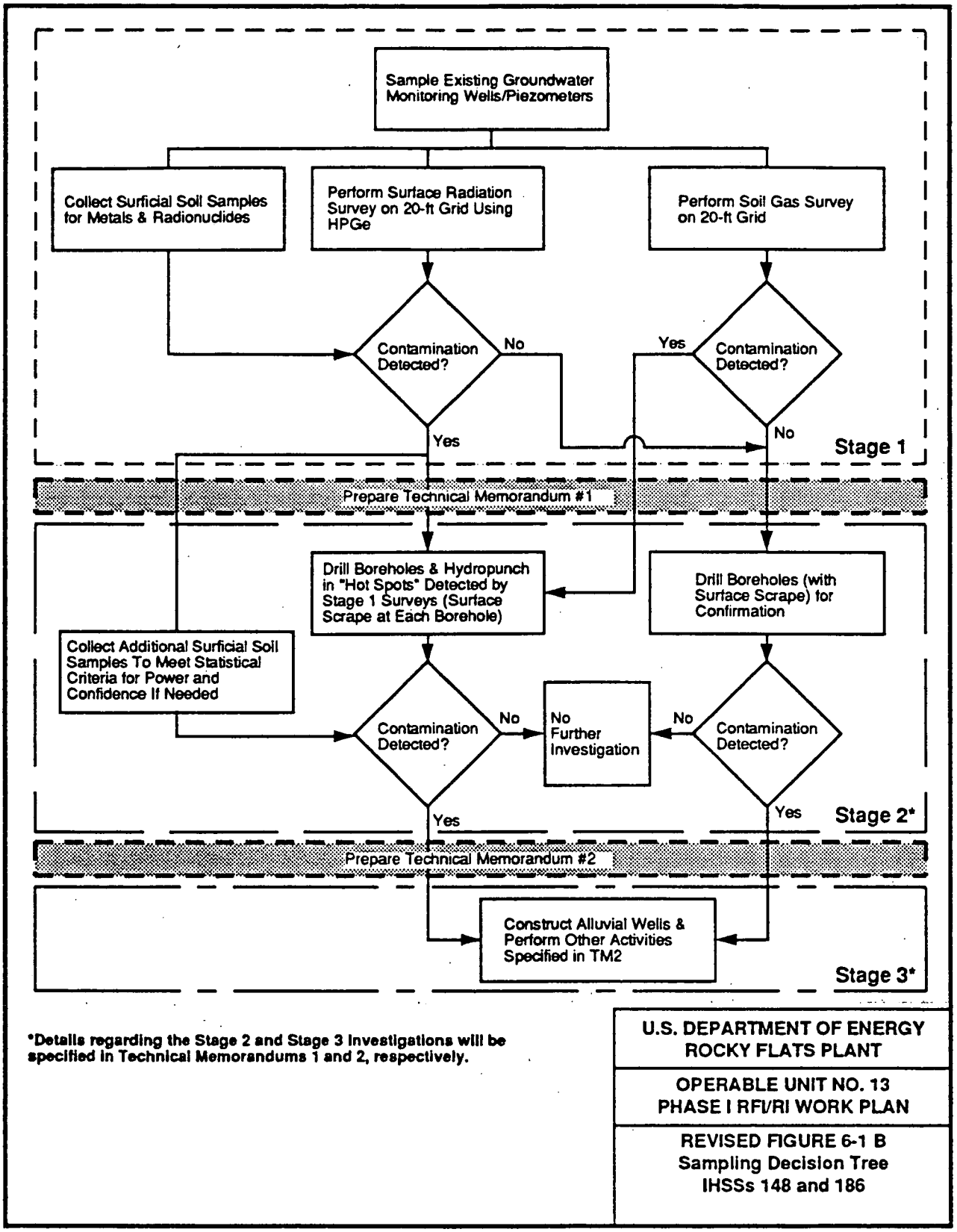
REVISED FIGURE 6-1 A
Sampling Decision Tree
IHSSs 117.1, 117.2, 117.3, 128, 134, 157.1, 158, and 197



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U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT

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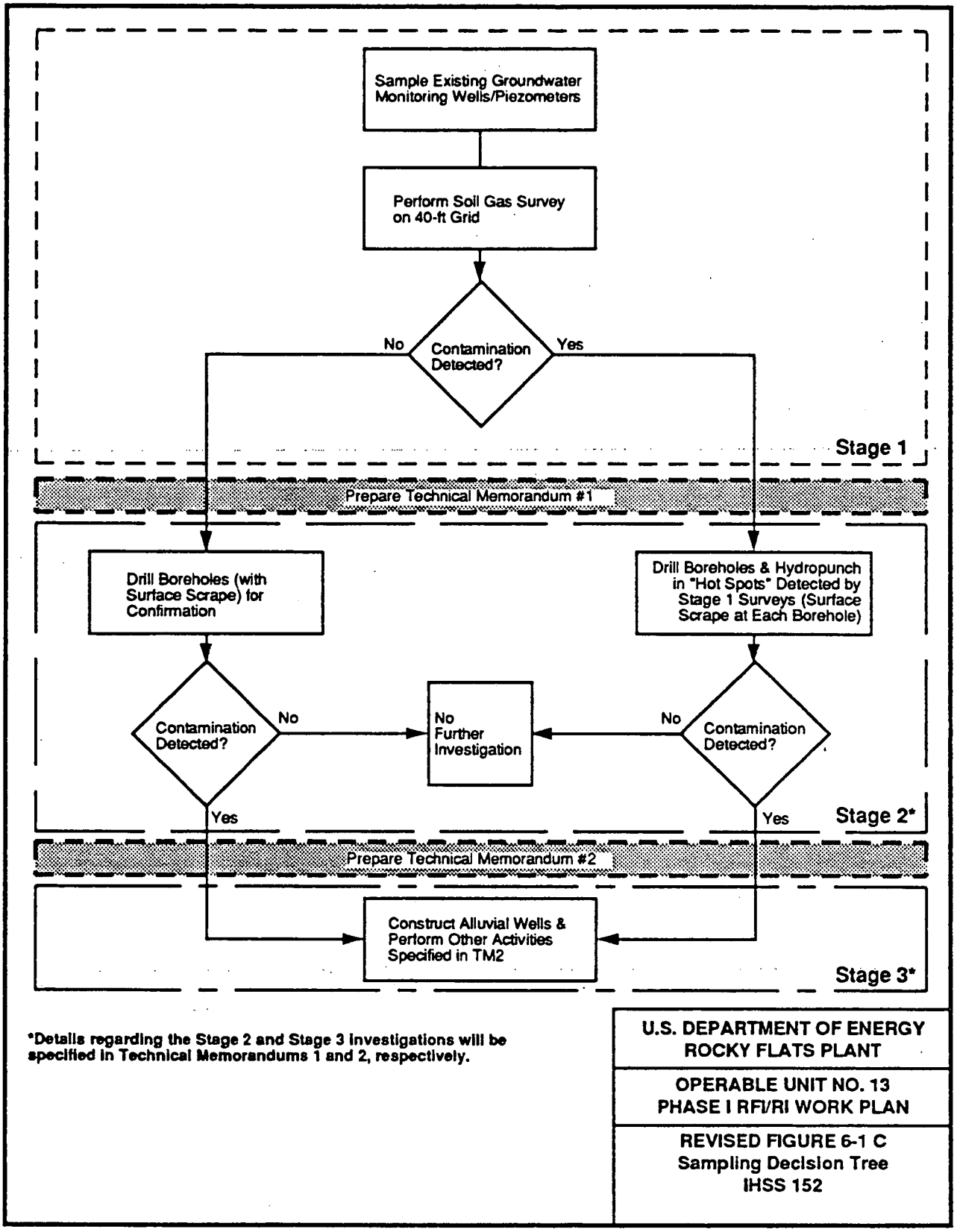
PHASE I RFI/RI WORK PLAN

REVISED FIGURE 6-1 B
Sampling Decision Tree
IHSSs 148 and 186



*Details regarding the Stage 2 and Stage 3 investigations will be specified in Technical Memorandums 1 and 2, respectively.

U.S. DEPARTMENT OF ENERGY
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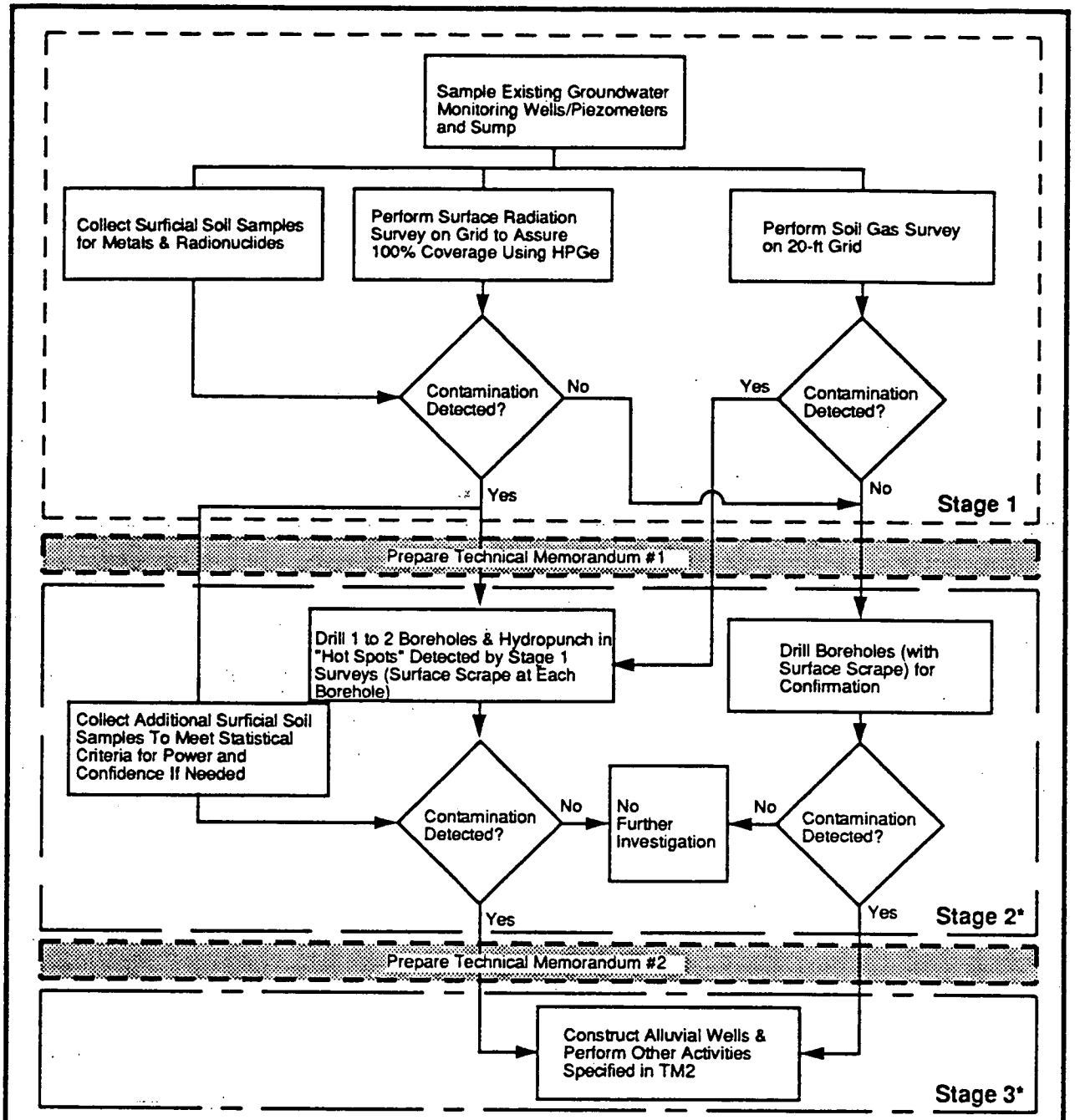
REVISED FIGURE 6-1 C
Sampling Decision Tree
IHSS 152



*Details regarding the Stage 2 and Stage 3 investigations will be specified in Technical Memorandums 1 and 2, respectively.

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REVISED FIGURE 6-1 D
Sampling Decision Tree
IHSS 171

TABLE 6.2 (Sheet 1 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
117.1	Provide documentation of materials/chemicals stored	NA	Provide documentation of materials/chemicals stored*	NA	In Agreement - Information Provided in Section 2.0
			Visual Inspection	NA	Identify visible contamination
			HPGe Radiological Survey	20' grid spacing	Investigate soil contamination indicated by Well P214689 - 100% coverage
	Soil Gas Survey	100' grid spacing	Soil Gas Survey	20' grid spacing	Improved Coverage - additional analytes added based on available data
			Surficial Soil Sampling	7 (11 within IHSS group which includes IHSS 197)	Investigate soil contamination with metals and radionuclides - confirm HPGe survey
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Sample Existing Wells/Piezometers	2	Provide cost-effective information regarding groundwater conditions
	Boreholes in Soil Gas Plumes	TBD	Boreholes in Soil Gas and Radiation Anomalies	TBD	In Agreement
	Boreholes (confirmatoin of soil gas)	TBD	Boreholes (confirmation of soil gas and radiation surveys)	TBD	In Agreement
	Monitoring Wells	TBD	Monitoring Wells	TBD	In Agreement
			Nested Tensiometers	TBD	Increased Coverage

• Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
NA = Not applicable TBD = To be determined •• This activity was performed during the preparation of this Work Plan

TABLE 6.2 (Sheet 2 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
117.3	Provide documentation of materials/chemicals stored	NA	Provide documentation of materials/chemicals stored*	NA	In Agreement - Information Provided in Section 2.0
			Visual Inspection	NA	Identify visible contamination
			HPGe Radiological Survey	20' grid spacing	Investigate soil contamination indicated by Well P214689 - 100% coverage
	Soil Gas Survey	100' grid spacing	Soil Gas Survey	20' grid spacing	Improved Coverage - additional analytes added based on available data
			Surficial Soil Sampling	11	Investigate soil contamination with metals and radionuclides - confirm HPGe survey
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Sample Existing Wells/Piezometers	2	Provide cost-effective information regarding groundwater conditions
	Boreholes in Soil Gas Plumes	TBD	Boreholes in Soil Gas and Radiation Anomalies	TBD	In Agreement
	Boreholes (confirmation of soil gas)	TBD	Boreholes (confirmation of soil gas and radiation surveys)	TBD	In Agreement
	Monitoring Wells	TBD	Monitoring Wells	TBD	In Agreement
			Nested Tensiometers	TBD	Increased Coverage

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TABLE 6.2 (Sheet 3 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
117.2			Visual Inspection	NA	Identify visible contamination
			HPGe Radiological Survey	20' grid spacing	Investigate possible contamination indicated by IHSS history
	Soil Gas Survey	100' grid spacing	Soil Gas Survey	20' grid spacing	Improved Coverage - additional analytes added based on available data
			Surficial Soil Sampling	6 (11 within IHSS group which inlcudes IHSS 158)	Investigate soil contamination with metals and radionuclides - confirm HPGe survey
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Asphalt Sampling	5	Investigate contamination of asphalt
			Sampling Existing Wells/Piezometers	2	Provide cost-effective information regarding groundwater conditions
	Boreholes in Soil Gas Plumes	TBD	Boreholes in Soil Gas and Radiation Anaomalies	TBD	In Agreement
	Boreholes (confirmation of soil gas)	TBD	Boreholes (confirmatoin of soil gas and radiation surveys)	TBD	In Agreement
			Nested Tensiometers	TBD	Increased Coverage
	Monitoring Wells	TBD	Monitoring Wells	TBD	In Agreement

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TABLE 6.2 (Sheet 4 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
128, 134, 171	Reevaluate IHSS location	NA	Reevaluate IHSS location*	NA	In Agreement - Information
			Visual Inspection	NA	Identify visible contamination
	FIDLER-GM Radiological Survey	10' grid spacing	HPGe Radiological Survey	20' grid spacing	Improved Technology
	Soil Gas Survey	25' grid spacing	Soil Gas Survey	20'grid spacing 40' grid spacing over extension of IHSS 134	Improved Coverage - additional analytes added based on available data
			Surficial Soil Sampling	8 - 171 11 - IHSS group 128, 134N, 171	Investigate soil contamination with metals and radionuclides - confirm HPGe survey
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Asphalt Sampling (Southern portion of IHSS 134)	4	Investigate contamination of asphalt
			Sample Existing Wells/Piezometers	3-IHSS 128 and IHSS 171 1-IHSS 134	Provide cost-effective information regarding groundwater conditions
	Boreholes in Soil Gas Plumes	TBD	Boreholes in Soil Gas and Radiation Anomalies	TBD	In Agreement
			Monitoring Wells	TBD	Increased Coverage
			Nested Tensiometers	TBD	Increased Coverage

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TABLE 6.2 (Sheet 5 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
148	Submit documentation of radiometric survey(s)	NA	Submit documentation of radiometric survey(s)*	NA	In Agreement - Information provided in Section 2.0
			Visual Inspection	NA	Identify visible contamination
	FIDLER-GM Radiological Survey	10' grid spacing	HPGe Radiological Survey	20' grid spacing	Improved Technology
			Soil Gas Survey	20' grid spacing	Investigate VOC contamination of groundwater in area
			Surficial Soil Sampling	11	Confirm HPGe results
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Asphalt Sampling	4	Investigate contamination of asphalt
			Sample Existing Wells/Piezometers	5	Provide cost-effective information regarding groundwater conditions
	Soil Borings	TBD	Boreholes in Soil Gas and Radiation Anomalies and near OPWS	TBD - 1 near OPWL during stage 1	In Agreement
			Nested Tensiometers	TBD	Increased Coverage
			Monitring Wells	TBD	Increased Coverage

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TABLE 6.2 (Sheet 6 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IIISS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
152			Visual Inspection	NA	Identify visible contamination
	Soil Gas Survey	20' grid spacing	Soil Gas Survey	40' grid spacing	Grid spacing sufficient to find large spills documented at the IIISS
			Sample Existing Wells/Piezometers	2	Provide cost-effective information regarding groundwater conditoins
	Soil Cores/Borings	TBD	Soil Borings	TBD - minimum of 3	In Agreement
			Nested Tensiometers	TBD	Increased Coverage
			Monitoring Wells	TBD	Increased Coverage

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TABLE 6.2 (Sheet 7 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IIISS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
157.1	Submit documentation of radiometric survey(s)	NA	Submit documentation of radiometric survey(s)*	NA	In Agreement - Information provided in Section 2.0
			Visual Inspection	NA	Identify visible contamination
	FIDLER-GM Radiological Survey	25' grid spacing	HPGe Radiological Survey	20' grid spacing	Improved Technology 100% coverage
			Soil Gas Survey	20' grid spacing	Investigate VOC contamination of groundwater in area
	Surficial Soil Sampling	TBD	Surficial Soil Sampling	11	In Agreement
			Vertical Soil Proviles	TBD	Aid interpretation of HPGe survey
			Sample Existing Wells/Piezometers	3	Provide cost-effective information regarding groundwater conditions
	Soil Borings	TBD	Soil Borings	TBD	In Agreement
			Nested Tensiometers	TBD	Increased Coverage
			Monitoring Wells	TBD	Increased Coverage

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TABLE 6.2 (Sheet 8 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
158			Visual Inspection	NA	Identify visible contamination
	FIDLER-GM Radiological Survey	25' grid spacing	HPGe Radiological Survey	20' grid spacing	Improved Technology 100% coverage
	Soil Gas Survey	25' grid spacing	Soil Gas Survey	20' grid spacing	Increased Coverage
	Surficial Soil Sampling	TBD	Surficial Soil Sampling	5	In Agreement
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Sample Existing Wells/Piezometers	4	Provide cost-effective information regarding groundwater conditions
	Boreholes in Soil Gas Plumes	TBD	Boreholes in Soil Gas and Radiation Anomalies	TBD	In Agreement
			Nested Tensiometers	TBD	Increased Coverage
			Monitoring Wells	TBD	Increased Coverage
169	Locate waste drum	NA	Document drum incident*	NA	Details of incident documented in Section 2.0

• Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
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TABLE 6.2 (Sheet 9 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IIISS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
186	Submit documentation of cleanup operations	NA	Submit documentation of cleanup operations*	NA	In Agreement - informatoin provided in Section 2.0
			Visual Inspection	NA	Identify visible contamination
			HPGe Radiological Survey	20' grid spacing	Increased Coverage to 100%
			Soil Gas Survey	20' grid spacing	Investigate VOC contamination of soils in area
			Surficial Soil Sampling	11	Confirm HPGe results
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Sample Existing Wells/Piezometers	2	Provide cost-effective information regarding groundwater conditions
	Soil Borings	TBD	Boreholes in Soil Gas and Radiation Anomalies - Boreholes along PWL	TBD - 4 boreholes along PWL	In Agreement
			Nested Tensiometers	TBD	Increased Coverage
			Monitoring Wells	TBD	Increased Coverage
190	Submit documentation regarding nature of leaks	TBD	Submit documentation regarding nature of leaks**	NA	In Agreement
191	Submit documentation regarding nature of spill	TBD	Submit documentation regarding nature of spill**	NA	In Agreement

* Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
NA = Not applicable TBD = To be determined ** This activity was performed during the preparation of this Work Plan

TABLE 6.2 (Sheet 10 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IIISS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
197	Originally in OU 16		Included with the investigation of IIISS 117.1 at the request of Colorado Department of Health and the Environmental Protection Agency	NA	Response to EPA and CDH requestor
			Visual Inspection	NA	Identify visible contamination
			HPGe Radiological Survey	20' grid spacing	100 % coverage - same as 117.1
			Soil Gas Survey	20' grid spacing	
			Surficial Soil Sampling	4	Investigate soil contamination with metals and radionuclides - confirm HPGe survey
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Sample Existing Wells/Piezometers	2	Provide cost-effective information regarding groundwater conditions
			Boreholes in Soil Gas and Radiation Anomalies	TBD	In Agreement
			Boreholes (confirmation of soil gas and radiation surveys)	TBD	In Agreement
			Monitoring Wells	TBD	In Agreement
			Nested Tensiometers	TBD	Increased Coverage

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NA = Not applicable TBD = To be determined •• This activity was performed during the preparation of this Work Plan

TABLE 6.3 (Sheet 1 of 5)
SUMMARY OF SAMPLING PROCEDURES USED IN OU13 STAGE 1 RFI/RI

IHSS	Sample Type	Applicable Standard Operating Procedures (SOPS)[1]
117.1	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
117.2	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Asphalt	Asphalt/concrete sampling SOP to be developed, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
117.3	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06

TABLE 6.3 (Sheet 2 of 5)
SUMMARY OF SAMPLING PROCEDURES USED IN OU13 STAGE 1 RFI/RI

IHSS	Sample Type	Applicable Standard Operating Procedures (SOPS)[1]
128	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
134	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Asphalt	Asphalt/concrete sampling SOP to be developed, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
148	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Asphalt	Asphalt/concrete sampling SOP to be developed, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Soil boring	FO.01, FO.03, FO.04, FO.08, FO.09, FO.10, F0.11, FO.12, FO.13, FO.14, FO.16, FO.18, FO.19, GT.01, GT.02, GT.03, GT.05, GT.08, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06

TABLE 6.3 (Sheet 3 of 5)
SUMMARY OF SAMPLING PROCEDURES USED IN OU13 STAGE 1 RFI/RI

IHSS	Sample Type	Applicable Standard Operating Procedures (SOPS)[1]
152	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
157.1	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
158	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
171	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
	Sump Water	SW.1, SW.2, SW.3, FO.03, FO.06, FO.07, FO.10, FO.13

TABLE 6.3 (Sheet 4 of 5)
SUMMARY OF SAMPLING PROCEDURES USED IN OU13 STAGE 1 RFI/RI

IHSS	Sample Type	Applicable Standard Operating Procedures (SOPS)[1]
186	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Soil boring	FO.01, FO.03, FO.04, FO.08, FO.09, FO.10, F0.11, FO.12, FO.13, FO.14, FO.16, FO.18, FO.19, GT.01, GT.02, GT.03, GT.05, GT.08, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06

TABLE 6.3 (Sheet 5 of 5)
SUMMARY OF SAMPLING PROCEDURES USED IN OU13 STAGE 1 RFI/RI

[1] Standard Operating Procedures (SOPs) -

FO.01, Air Monitoring and Dust Control
FO.03, General Equipment Decontamination
FO.04, Heavy Equipment Decontamination
FO.05, Handling of Purge and Development Water
FO.07, Handling of Decontamination Water and Wash Water
FO.08, Handling of Drilling Fluids and Cuttings
FO.09, Handling of Residual Samples
FO.10, Receiving, Labeling, and Handling Environmental Materials Containers
FO.11, Field Communications
FO.12, Decontamination Facility Operations
FO.13, Containerization, Preserving, Handling and Shipping of Soil and Water Samples
FO.14, Field Data Management
FO.15, Photoionization Detectors (PIDs) and Flame Ionization Detectors (FIDs)
FO.16, Field Radiological Measurements
FO.18, Environmental Sample Radioactivity Content Screening
FO.19, Base Laboratory Work
GT.01, Logging Alluvial and Bedrock Material
GT.02, Drilling and Sampling Using Hollow Stem Auger Techniques
GT.03, Isolating Bedrock from Alluvium with Grouted Surface Casing
GT.04, Rotary Drilling and Rock Coring
GT.05, Plugging and Abandonment of Boreholes
GT.06, Monitoring Wells and Piezometer Installation
GT.08, Surface Soil Sampling
GT.09, Soil Gas Sampling and Field Analysis
GT.10, Borehole Clearing
GT.11, Plugging and Abandonment of Wells
GT.17, Land Surveying
GT.19, Field Gas Chromatographs
GW.01, Water Level Measurements in Wells and Piezometers
GW.02, Well Development
GW.05, Field Measurement of Groundwater Field Parameters
GW.06, Groundwater Sampling
SW.1, Surface Water Collection Activities
SW.2, Field Measurement of Surface Water Parameters
SW.3, Surface Water Sampling

References -

EG&G, 1991, Rocky Flats Plant EMD Operating Procedures Manual, Volume II: Groundwater, Manual No. 5-21200-OPS-GW.
EG&G, 1992, Rocky Flats Plant EMD Operating Procedures Manual, Volume I: Field Operations, Manual No. 5-21200-OPS-FO.
EG&G, 1992, Rocky Flats Plant EMD Operating Procedures Manual, Volume III: Geotechnical, Manual No. 5-21200-OPS-GT.
EG&G, 1992, Rocky Flats Plant EMD Operating Procedures Manual, Volume IV: Surface Water, Manual No. 5-21200-OPS-SW.

During all stages of the investigation, any anomalies detected will be investigated until the anomalies are completely mapped. For example, if soil gas anomalies continue beyond the present IHSS boundaries, additional soil gas samples will be collected and analyzed outside the IHSS boundaries until the anomalies are completely mapped or the boundary of a neighboring IHSS is encountered. If the adjoining IHSS is located in another operable unit, sampling within that IHSS will be coordinated with the appropriate Operable Unit Manager, to ensure that the anomalies are completely mapped.

The objectives for each of these activities are summarized in Section 5, Table 5.2.
The rationale for sampling groundwater from the existing wells and piezometers in the vicinity of OU 13 is based on the fact that the current quality of the groundwater beneath the operable unit is not known. Groundwater quality data is available for only one well located within OU 13. Sampling of the existing wells and piezometers provides a cost-effective means for better assessing groundwater conditions within the operable unit, and for analyzing the groundwater conditions that are being modeled site-wide. The data obtained from this activity will also enable a more complete evaluation of the analytical data that currently exists for these wells and piezometers in and around OU 13.

Upon completion of Stage 1, the data collected during Stage 1 screening activities will be evaluated so that subsequent stages of the investigation can be adequately planned. Results from applicable site-wide studies, Stage 1 data and recommendations for Stage 2 investigations will be summarized in a technical memorandum. Due to the turn-around times involved with obtaining laboratory results, this technical memorandum may not provide complete results of the laboratory analysis of borehole, surficial soil, and groundwater samples.

Stage 2 sampling will be used to confirm the results of the Stage 1 surveys where no contamination was found and to provide additional information on those sites where contamination was found to be present. Activities to be conducted under Stage 2 include:

- Additional surficial soil sampling (if needed);
- Surface scrape sampling (at borehole locations);

- Borehole sampling; and
- Real time sampling of groundwater using the Hydropunch®, or equivalent, technology at borehole locations.

Upon completion of Stage 2, data collected during Stages 1 and 2, and appropriate site-wide data, will be fully evaluated to determine if further investigation of each IHSS, PAC or PIC is required. The results of Stages 1 and 2 and the Stage 3 FSAP will be summarized in a technical memorandum.

Because Stage 3 relies on data collected in Stages 1 and 2, sampling needs are the hardest to predict. Stage 3 will attempt to assess if there has been migration of contamination from IHSSs determined to be sources of contamination in Stages 1 and 2. It is currently anticipated that groundwater monitoring wells will be required to assess contaminant migration. To the extent possible, existing wells and piezometers will be used. Based on the proximity of several IHSSs to one another, it is also anticipated that some wells may be used to assess contamination attributable to more than one IHSS.

More extensive methods of sampling may be required on a case by case basis. It may be possible to employ the Hydropunch®, or equivalent, technology to outline the extent of the contaminant plumes in the subsurface. It may also be necessary to evaluate possible hydraulic connection between the Rocky Flats Alluvium and the Arapahoe Formation if the borings installed during Stage 2 indicate that a porous and permeable (No. 1) sandstone subcrops beneath the alluvium near a particular IHSS(s). At IHSSs where no contamination was found during screening level activities, a sufficient number of boreholes will be drilled and sampled during State 2 to confirm that there is no contamination. The number of borings required will be based on:

- the size of the IHSS,
- inventory of waste storage at the site, and
- probability of below-ground releases.

At IHSSs where contamination was found, Stage 2 will consist of at least three borings transecting each anomaly down gradient from the point of highest concentration. A maximum of three transects (9 boreholes) will be planned for each IHSS as Stage 2 activities.

Further borehole data needed to complete characterization or locate groundwater wells will be identified in the technical memorandum prepared after Stage 2 is complete.

If the results of Stages 1 and 2 indicate the need for sampling other environmental media, such as surface water and sediments, these investigations will be implemented during Stage 3.

The applicability of vadose zone monitoring and sampling techniques in the OU 13 area will also be investigated. The results of vadose zone investigations for Operable Unit 12 and the Sewage Treatment Plant (STP) will be reviewed for applicability to OU 13. The spatial relationship of potential contamination sources to unpaved areas which can serve as conduits for infiltration and groundwater recharge will be identified in the technical memorandum prepared at the completion of Stage 2. The following methods will also be evaluated for use in that technical memorandum.

One method to measure soil moisture profiles at unpaved IHSSs is through the use of vertically-nested tensiometers or equivalent instruments. Tensiometers can be inserted by drilling small diameter boreholes either with hand augers or with a vehicle mounted hydraulic probe. Subsurface geologic conditions may limit the success of these installation methods. Transducers connected to the tensiometers produce *in situ* readings of soil-water pressure which are recorded electronically in digital form. Soil-water pressure measurements are then used to determine response of vadose zone moisture to precipitation events, and to evaluate whether soil wetting fronts reach the water table. In areas where infiltration is found to reach the water table, a potential method to be used in evaluating the mobility of contaminants present in the vadose zone is leaching tests. Leachability data are used to substantiate whether individual IHSSs are current contributors to observed groundwater contamination. SOPs do not currently exist for vadose zone monitoring and leachability testing but are developed as part of OU 4 investigations. The SOPs and some results are scheduled to be available in time to include in the Stage 2 Technical Memorandum.

6.2.3 Analytical Rationale

The potential contaminants present for each IHSS in OU 13 are listed in Table 5.3. These contaminants were identified through a review of the information provided in Section 2.0 and the Historical Release Report (July 1992). Together with the analytes specified by the IAG, these provide the basis for the analytical parameters for this investigation. However, the operational histories and release histories are not clearly defined for many of the IHSSs, and the available analytical data indicate the presence of contaminants in or near some IHSSs not known to have been released in these IHSSs. Therefore, it is necessary to utilize a more comprehensive list of analytes. The specific analytes that will be used for each stage of the Phase I RFI/RI are presented in Table 6.4 (also see Table 5.3).

Analytical results from the sampling will dictate future analytical parameters. Utilization of the parameters listed in Table 6.4 may be modified as appropriate based on additional data compilation to provide maximum potential for identifying all possible contaminants present in OU 13. Analytes for later stages will be selected based on concentration levels exceeding values identified by the Background Geochemical Characterization Report and updates to that report. Decisions regarding analytical parameter selection will be documented by submitting technical memoranda.

6.2.4 Relevant Studies of Other OUs

Current and planned investigations at other OUs may provide data relevant to the Phase I investigation of OU 13. Although areas of overlap with other OUs do not imply a reduction in scope of the Phase I investigation of OU 13, such overlaps will be examined to prevent duplication of effort. Provided that the specified objectives of the OU 13 Phase I RFI/RI are achieved, data from studies of other OUs shall be utilized to supplement or replace activities in OU 13. These determinations will be made on a case-by-case basis. Decisions regarding use of data from studies of other OUs will be documented by submitting technical memoranda.

For example, the Final Preassessment Site Investigation for the Building 374 Waste System Evaporator will provide data applicable to IHSSs 158 and 186. Surface soil samples are to be

TABLE 6.4 PHASE I, STAGE 1, ANALYTICAL PROGRAM

Parameters		IHSS										
		117 .1 & 197	117.2	117.3	128 & 134(N)	134(S)	148	152	157.1	158	171	186
HPGe Survey [a]		X	X	X	X		X		X	X	X	X
Soil Gas Analyses [b]		X	X	X	X	X	X	X	X	X	X	X
OU13 Soil Gas Surveys												
1.1.1-Trichloroethane	IAG Required	X	X	X					X	X		
	Indicated by Available Data						X					
Dichloromethane	IAG Required	X	X	X								
	Indicated by Available Data						X			X		
Perchlorethene	IAG Required	X	X	X					X	X	X	
	Indicated by Available Data				X		X					
Trichloroethane	IAG Required	X	X	X					X	X	X	
	Indicated by Available Data						X					
Benzene	IAG Required	X	X	X	X			X		X		
	Indicated by Available Data											X
Carbon Tetrachloride	IAG Required	X	X	X						X	X	
	Indicated by Available Data											
Total Xylenes	IAG Required				X			X				
	Indicated by Available Data	X	X	X						X		X
Toluene	IAG Required				X			X		X		
	Indicated by Available Data	X	X	X								X
Carbon Disulfide	IAG Required											
	Indicated by Available Data	X			X					X	X	X
Acetone	IAG Required								X	X		
	Indicated by Available Data	X	X		X		X				X	X
Ethylbenzene	IAG Required											
	Indicated by Available Data	X	X							X		X
2-Butanone	IAG Required											
	Indicated by Available Data		X							X		
Chloroform	IAG Required								X		X	
	Indicated by Available Data						X					
1.1-Dichloroethane	IAG Required								X			
	Indicated by Available Data						X					
1.2 Dichloroethane	IAG Required									X		
	Indicated by Available Data											
Methylene Chloride	IAG Required										X	
	Indicated by Available Data											

TABLE 6.4 PHASE I, STAGE 1, ANALYTICAL PROGRAM

Parameters	IHSS										
	117 .1 & 197	117.2	117.3	128 & 134(N)	134(S)	148	152	157.1	158	171	186
Surficial Soil Analyses											
TAL Metals	X	X	X		X			X	X		
Lithium				X	X					X	
Magnesium				X	X					X	
Radionuclides – Full Suite [c]	X	X	X	X	X	X		X	X	X	X
Laboratory HPGe [d]	X	X	X	X	X	X		X	X	X	X
Asphalt Analyses											
Laboratory HPGe [d]		X			X	X					
Borehole Samples											
TAL Metals						X					X
TCL Volatiles											X
TCL Demivolatiles											X
Laboratory HPGe [d]						X					X
Nitrate						X					X
Chloride						X					
Sulfate						X					
Groundwater Analyses											
TAL Metals	X	X	X	X	X	X	X	X	X	X	X
TCL Volatiles	X	X	X	X	X	X	X	X	X	X	X
TCL Semivolatiles	X	X	X	X	X	X	X	X	X	X	X
Radionuclides – Full Suite [c]	X	X	X	X	X	X	X	X	X	X	X
Anions [e]	X	X	X	X	X	X	X	X	X	X	X
Field Parameters [f]	X	X	X	X	X	X	X	X	X	X	X
Sump Liquids Analyses											
TAL Metals										X	
TCL Volatiles										X	
TCL Semivolatiles										X	
Radionuclides – Full Suite [c]										X	
Field Parameters [f]										X	

a Vertical Profile Samples Will Also Be Taken at Selected Locations for Analysis with a Laboratory HPGe
b All Soil Gas Samples Will Be Analyzed in the Field for the Constituents Listed in Section 6.3.1.1 to 6.3.1.11 for Each IHSS
c Analysis of the Following Radionuclides at a Radiochemistry Laboratory – Gross Alpha, Gross Beta, Amercium 241, Plutonium 239/240, Tritium, Uranium 233/234, Uranium 235, and Uranium 238
d Analysis of Samples for Gamma-Emitting Radionuclides with a Laboratory HPGe, or Appropriate Radiochemical Analysis
e Chloride, Fluoride, Nitrate, and Sulfate.
f Temperature, pH, and Specific Conductance

See Table 5.3 for a Complete List of Analytes, Detection Limits, and Analytical Methods

collected from IHSS 158 and surface and subsurface soils are to be collected from IHSS 186 as part of this investigation. When the results of this investigation become available, they will be evaluated and presented in the technical memorandum prepared prior to Stage 2 and/or Stage 3.

6.3 SAMPLING PROGRAM

This section describes the Phase I RFI/RI investigation activities at each IHSS, PAC and/or PIC including sample locations and frequencies. The sampling programs for each IHSS are shown in Figures 6-1A to 6-1D and are described in detail in the following sections. The sampling activities and analytical program for each IHSS are summarized in Tables 6.1 and 6.4, respectively. As described in Section 2.2, it is likely that there would be no detectable impacts to environmental media as a result of the releases known to have occurred in IHSSs 190 and 191. Section 2.2 also provides information which indicates that the burial of the drum of hydrogen peroxide in IHSS 169 probably did not occur and is the same incident as that described for IHSS 191. Regardless of the potential location of this incident, it is not likely that there would be detectable impacts attributable to it. Therefore, no further investigation of IHSS 169 and IHSS 191 is proposed. That portion of IHSS 190 which includes the Central Avenue Ditch will be investigated as part of the integrated field sampling plan under development by EG&G (described in the OU 12 Work Plan). Additional investigation of PACs and PICs presented in the HRR (July 1992) are discussed in Section 6.3.1.15.

6.3.1 Stage 1 Investigation

Stage 1 sampling efforts include a visual inspection, surface radiological and soil gas surveys, limited numbers of soil borings, surficial soil sampling, vertical profile sampling, and sampling of existing groundwater monitoring wells and piezometers. Sections 6.3.1.1 to 6.3.1.14 define the details of the Stage 1 sampling program for each IHSS. In general, with the exception of sampling existing wells and piezometers, Stage 1 activities will be conducted in the order of surface radiological surveys, visual inspections, collection of surficial soil samples, soil gas surveys, and drilling of boreholes. Figure 6-2 illustrates the locations of the existing wells and piezometers to be sampled during Stage 1 and provides an indication to which IHSSs the groundwater data

collected will be applicable. These wells and piezometers will be sampled once for the analytes specified in Table 6.4. Visual field inspection of each IHSS, PAC and PIC is necessary to identify or confirm the possible hazards such as steam pipes and overhead utilities, and to delineate paved and unpaved areas. These factors may present an opportunity to expand, or force restriction of the proposed sampling grids.

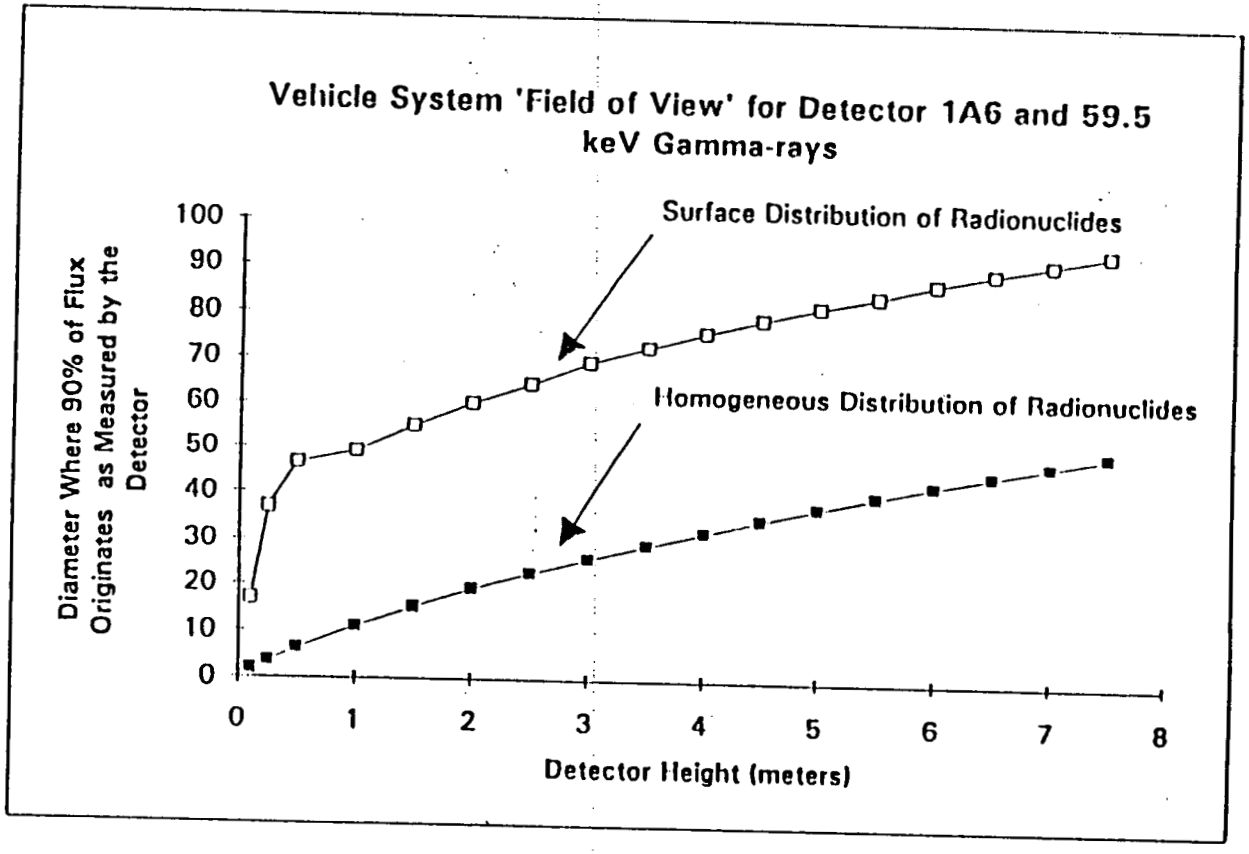
Surficial soils sampling locations need to be identified and properly biased with respect to current storage areas and stained soils and/or pavement. This field inspection can occur concurrently with the radiological survey. Eleven samples per IHSS group was determined to be statistically sufficient to detect contamination at those IHSS groups with a 95 percent probability (see Section 5.1.2.5.3).

The goal of the radiological survey is to screen 100 percent of the IHSS surface areas for radiochemical contamination. Surface radiological survey techniques will include high purity germanium (HPGe) radiological surveys supplemented with other detectors such as Fidler/NaI if needed. The HPGe detector was selected for these surveys instead of the G-M or FIDLER instruments specified by Table 5 of the IAG because the HPGe will provide greater areal coverage and higher quality results. The HPGe gamma ray detector that will be used is capable of high resolution gamma ray spectroscopy enabling the identification and quantification of gamma-emitting radionuclides. The detector is mounted on either a tripod or a vehicle. It is placed a set distance above the ground surface to measure gamma rays which originate from surface media. Table 6.5 shows the height of the detector and the size of the area that it measures. Both vehicle- and tripod-mounted HPGe instruments are currently available and in use at RFP.

The detector system integrates gamma activity over the detector's "field of view," a volume defined by which 90 percent of those gammas originating in the surface media are measured. It is assumed that radionuclide distribution is relatively homogenous over the field of view, and that the distribution varies only with depth. HPGe results are typically reported as concentration per unit mass, picoCuries per gram (pCi/g).

TABLE 6.5

Detector Height (m)	Diameter 'Field of View' (meters) Source Distribution: Homogeneous	Surface
0.1	1.8	16.9
0.25	3.6	36.8
0.5	6.3	46.6
1	11.1	49.3
1.5	15.3	55.2
2	19.2	60.3
2.5	22.7	64.6
3	26	69.5
3.5	29.2	73
4	32.2	76.4
4.5	35	79.4
5	37.7	82.2
5.5	40.3	84.6
6	42.8	87.4
6.5	45.3	89.9
7	47.7	92.1
7.5	50.1	94.5



The grid size for the HPGe stations can be adjusted to provide 100 percent coverage of the area to be investigated in the most cost effective manner. For example, in wide open areas, the vehicle-mounted tripod can measure a circular area up to 51m in diameter. This can save time and lower costs. In confined, obstructed, or cluttered locations, the mast height can be reduced or a tripod-mounted detector used. The tripod grid is usually set at 20 feet (6.1m) because the detector will measure a circular area 35 feet (10.7m) in diameter when it is set one meter from the surface.

The HPGe stations are shown on a twenty foot grid in this work plan to conservatively estimate the number of stations required for 100 percent coverage. The grid will be adjusted upon the visual inspection.

Screening level activities for chemical contamination will consist of soil gas surveys and surficial soil sampling. Soil gas sampling will be conducted with a vehicle equipped with a hydraulic probing rig. This system has the advantage of allowing sampling to depths of 25 feet and extraction of soil vapor samples from discrete soil intervals without the introduction of surface air into the hole. After an access hole has been cut through concrete or pavement, if present, the rig will be set up on each sampling point. To collect a soil gas sample, the sampling probe will then be driven to a depth of 5 feet (in most cases). The retracting tip will be pulled back, and a vacuum applied to obtain the soil gas sample. The sample is to be collected with a gas tight syringe and injected directly into the gas chromatograph. The sample will be analyzed in a mobile laboratory for the analytes specified in the following sections for each IHSS and results will be obtained within minutes. The analytes specified for each IHSS include those required by the IAG and those indicated by the available analytical data presented in Section 2.0 and in the HRR. The analytes selected based on the information presented in Section 2.0 are those VOCs detected in borehole or groundwater samples from the nearest downgradient well(s) to each IHSS.

Analytical results will be presented in units of micrograms per liter (μg/L), the unit of measurement specified in EPA analytical methods references. Conversion to percentage, parts per million (ppm), or parts per billion (ppb) is dependent upon several factors, including the molecular weight of the individual compounds, air temperature, and air pressure. Detection limits for the listed

analytes will be in the sub-µg/L range. Detection limits will be a function of detector type, injection volume, and specific analyte response.

Because the available historical data indicate the potential for contamination with metals at several OU 13 IHSSs, surficial soil samples will be taken during Stage 1 to determine the presence or absence of contamination. Effective field screening methods for metals in soil samples are not currently available, thus requiring that the soil samples collected be sent to a laboratory for analysis. These samples will also be analyzed for radionuclides in either an onsite laboratory with a shielded HPGe detector or a radiochemistry laboratory. This analysis will assist in augmenting the results of the HPGe survey. At sites (IHSSs 148 and 186) where the potential exists for subsurface introduction of contamination that would not be detected in surficial soil samples, drilling of soil borings will substitute for or supplement the collection of surficial soil samples. Analysis of samples in a radiochemistry laboratory will also determine the concentration of non-gamma-emitting radionuclides.

Surficial and subsurface soil samples that will be measured with a laboratory HPGe will be stored in containers for 30 days to allow radon gas to equilibrate with parent radionuclides present in the soil matrix. After 30 days, a shielded HPGE will be used to detect concentrations of gamma-emitting radionuclides in the samples.

The field sampling program described in the following sections for each IHSS provides for screening and surficial soil sampling to be initially completed on standard grids, with additional sampling points added to further define anomalous readings. The use of quick and relatively inexpensive screening methods allows the determination of general site conditions as well as the qualitative identification of contaminated areas at each IHSS. It is realized that the success of such methods is somewhat dependent on subsurface geology in the OU 13 area.

The HPGe survey is most useful at detecting radioactivity on the surface of the ground. At those IHSSs where the surface is unchanged from the time of the potential release, the area will be surveyed as described above to identify radionuclide concentrations at the surface.

In areas where the pavement may have been applied or the surface altered after the releases of interest, measurement of that radioactivity may become much more difficult. The surfacing materials block most of the gamma ray emission associated with the source below the pavement. It is likely, however, that if the source was highly radioactive, a radioactive anomaly would be detected. Therefore, two methods of investigation will help insure that anomalous areas are identified. First, results will be carefully evaluated. Then, a few random asphalt samples will be taken to compare with the HPGE readings. The asphalt samples will be taken with a plug type corer and measured with either standard radiochemical analysis or with an onsite laboratory HPGe instrument. The SOPs for both the asphalt sampling and analysis and the laboratory HPGe instrument are currently being developed. They will be submitted to the regulatory agencies for approval prior to use in the field.

The second method is to take a soil sample as part of the surficial soils sampling plan from below the pavement and have it analyzed for radionuclides. The procedure for sampling below the pavement is currently being revised and will be submitted to the agencies for their approval prior to using the procedure in the field. Basically, the pavement will be removed and a grab sample will be taken, as described in the existing SOP GT.8, of the material directly below the pavement. After that sample is taken, another sample will be taken from below any obvious roadbase or preparation bed, or 4 feet deeper, whichever occurs first. These same samples will be analyzed for TAL metals and any other IHSS-specific metals listed in the IHSS sections below.

As discussed above, minimal numbers of surficial soil and depth profile samples will be collected to augment the results of the HPGe survey. At the time surficial soil samples are collected for analysis of nonradioactive parameters, the samples collected will be split and submitted for analysis of radionuclides. At those IHSSs where surficial soil sampling programs for nonradioactive parameters are not planned, surficial soil samples will be collected for analysis of radionuclides at a subset of the HPGe stations. After the completion of the HPGe surveys, the resultant data will be analyzed and used to locate vertical profile samples.

6.3.1.1 North Chemical Storage Site (IHSS 117.1) and Scrap Metal Sites (IHSS 197)

Stage 1 sampling efforts for IHSS 117.1 and IHSS 197 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-3 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet unless conditions warrant using larger spacing for the HPGe. The analytical data available for borehole samples from well P214689, located within this IHSS, indicate that soils in the area contain above background concentrations of several radionuclides necessitating the performance of the surface radiological survey. Because the size of possible releases within this IHSS are not known, the 20-foot grid spacing for soil gas surveys will provide a conservative approach to locating contamination. Due to access and security restrictions, these investigations will not be performed within that section of the IHSS which is believed to extend into the Protected Area. This portion of the IHSS will be addressed as part of the Decommissioning and Decontamination Program at RFP. The available information regarding releases at this IHSS indicates that these releases occurred prior to the area being paved. Thus, these investigations will focus on the potential contamination of soils beneath the pavement. The portion of this IHSS that is paved will require access holes to be cut through the pavement prior to initiating these investigations. As discussed in Section 6.3.1.12, the HPGe and soil gas surveys for this IHSS will also provide information regarding releases associated with IHSS 186.

The surface radiological survey will be performed with the HPGe instruments. Fidler/NaI will be used around obstructions to confirm that they are not sources of radiation which could influence the results of the HPGe measurements. Subsequent to the HPGe survey, surficial soil samples will be collected from eleven locations for analysis of TAL metals and radionuclides (Figure 6-3). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to augment the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

IAG Required

1,1,1-trichloroethane	perchloroethene	benzene	carbon tetrachloride
dichloromethane	trichloroethene		

Indicated by Available Data

total xylenes	carbon disulfide	acetone ethylbenzene
toluene		

Analyses of groundwater samples from existing piezometers P214689 and P115589 will provide data which may be useful in assessing potential contamination associated with IHSS 117.1 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

6.3.1.2 Middle Chemical Storage Site (IHSS 117.2)

Stage 1 sampling efforts for IHSS 117.2 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-4 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. Because the size of possible releases with this IHSS are not known, the 20-foot grid spacing for the soil gas survey will provide a conservative approach to locating contamination. The available information regarding releases at this IHSS indicates that these releases occurred both before and after the IHSS was paved. Thus, the investigation of this IHSS will focus on potential contamination of the asphalt as well as the soils beneath the asphalt. The entire area of IHSS 117.2 is paved, requiring access holes be cut through the pavement prior to performing investigations of potential contamination in the soils beneath the pavement. The presence of a numerous items that are stored in this IHSS and of a large storage tent will not allow for the performance of these activities over the entire area of the IHSS (Figure 6-4). To the extent possible, stored items in this IHSS will be

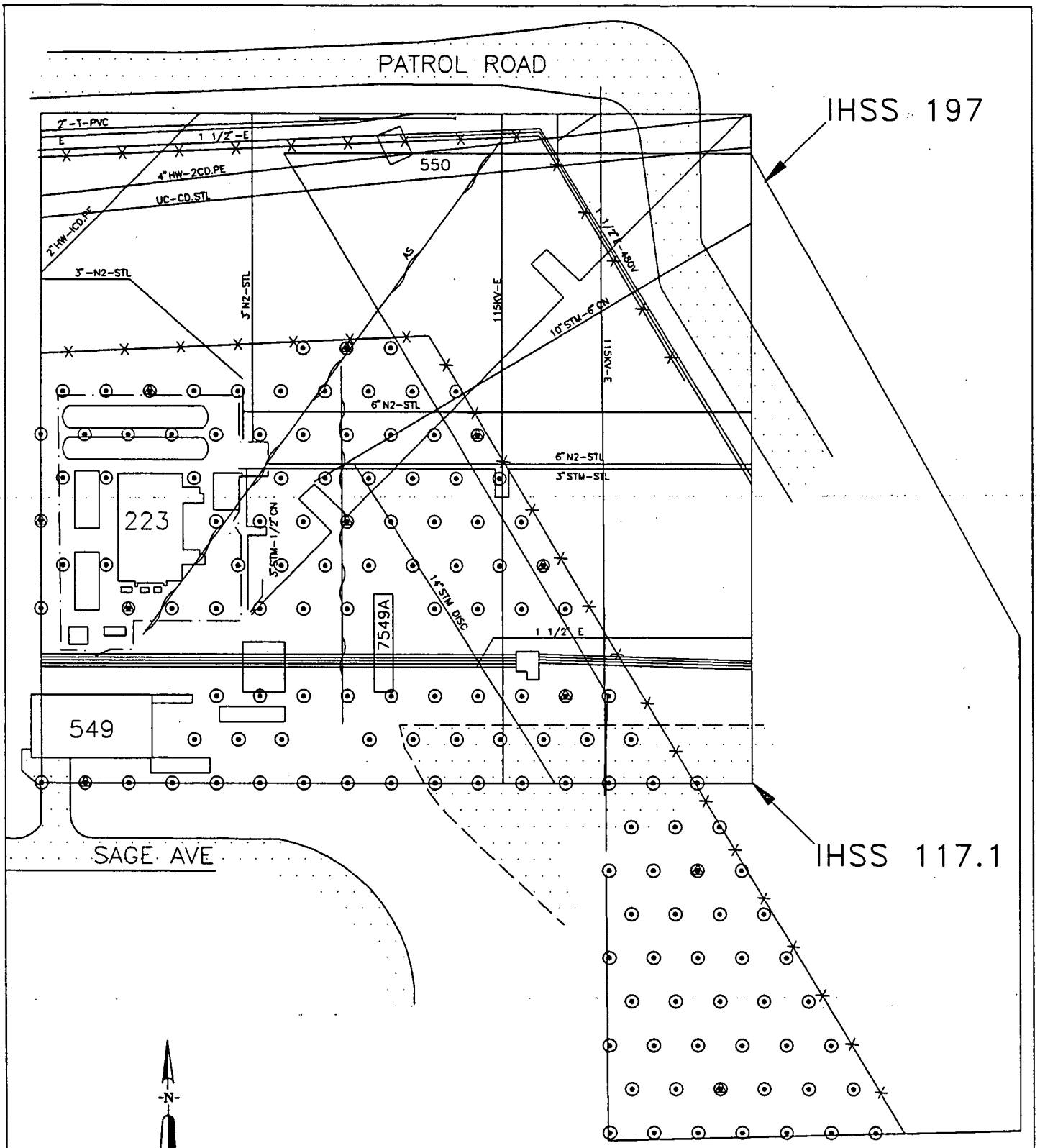


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FIGURE 6-3

IHSS SAMPLING LOCATIONS
IHSS 117.1 & IHSS 197

moved around to allow for sampling. The sampling grid was adjusted to reflect these restrictions and may be adjusted again to reflect the latest information available from the visual inspections.

The surface radiological survey will initially be performed with the HPGe instrument mounted on a tripod to measure concentrations of radionuclides on the pavement surface. After the results of this survey have been evaluated, samples of asphalt will be collected at a maximum of 5 anomalous areas detected by this survey. These samples will be analyzed with a laboratory HPGe. Subsequent to this survey, surficial soil samples will be collected from eleven locations in the combined IHSS 117.2 and IHSS 158 area for analysis of TAL metals and radionuclides (Figure 6-4). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to augment the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

<u>IAG Required</u>			
1,1,1-trichloroethane	perchloroethene	benzene	carbon tetrachloride
dichloromethane	trichloroethene		
<u>Indicated by Available Data</u>			
total xylenes	acetone	toluene	2-butanone
ethylbenzene			

Analyses of groundwater samples from existing piezometers P214689, P115589, P115689, and P215789 will provide data which may be useful in assessing potential contamination associated with IHSS 117.2 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

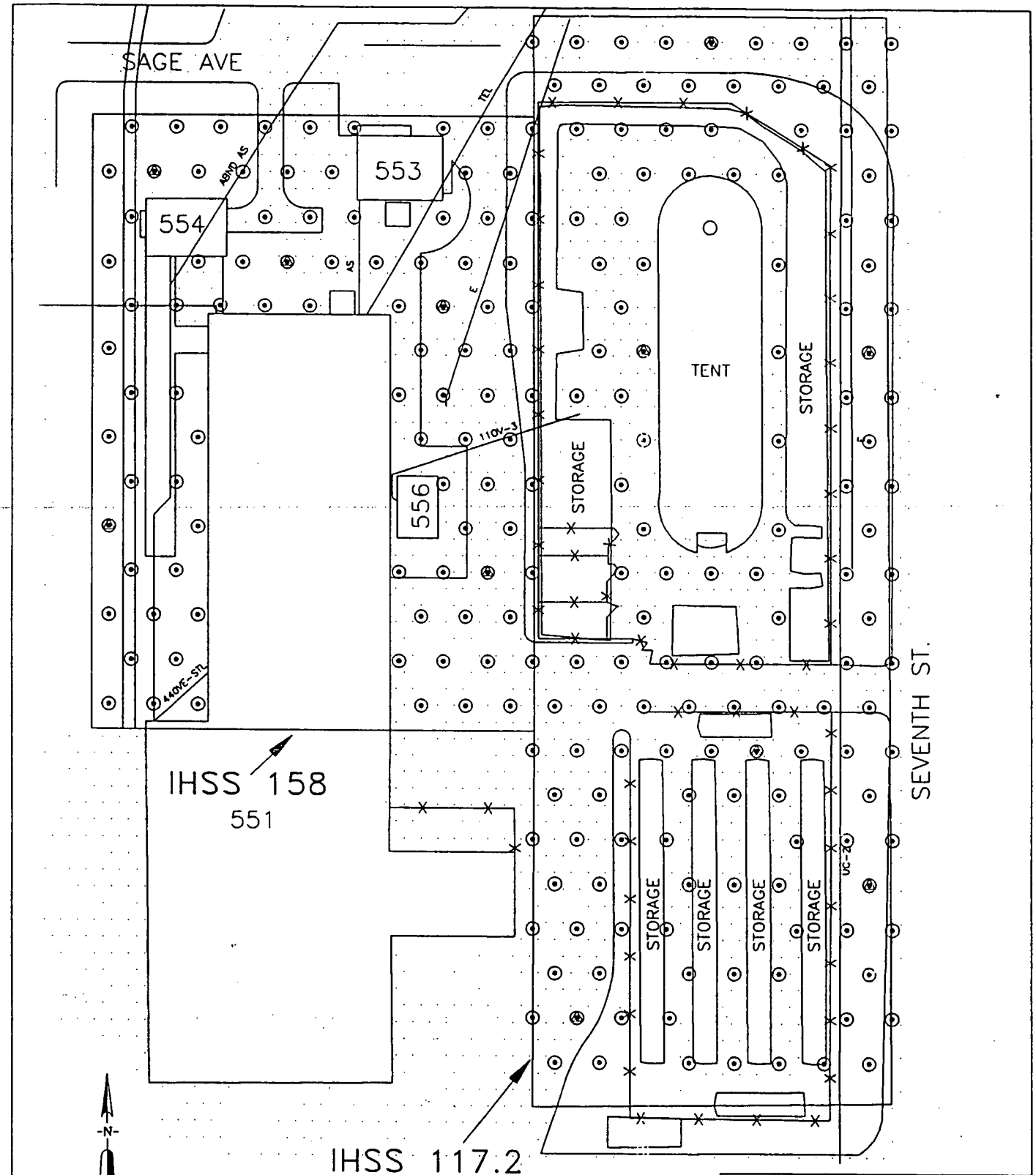

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FIGURE 6-4

IHSS SAMPLING LOCATIONS
IHSS 158 & IHSS 117.2

6.3.1.3 South Chemical Storage Site (IHSS 117.3)

Stage 1 sampling efforts for IHSS 117.3 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-5 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet and 40 feet, respectively. The soil gas survey of this IHSS will be performed in conjunction with that of IHSS 152 (Section 6.3.1.7). These surveys will be conducted over the entire area of the IHSS to the extent possible. The presence of Tank 224 and equipment associated with that tank will prevent the performance of these surveys over a portion of the IHSS within the berm for that tank.

The surface radiological survey will be performed with HPGe instruments over the area of this IHSS that is outside the berm around Tank 224. Due to the fact that the area within the berm was disturbed considerably during the construction of Tank 224, it is not likely that surface contamination attributable to this IHSS would be detectable within the bermed area. Subsequent to the HPGe survey, surficial soil samples will be collected at eleven locations in the combined IHSS 117.3 and IHSS 152 area for analysis of TAL metals and radionuclides (Figure 6-5). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to augment the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey of the area of IHSS 117.3 will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

IAG Required

1,1,1-trichloroethane	perchloroethene	benzene	carbon tetrachloride
dichloromethane	trichloroethene		

Because IHSS 152 also occurs in the same area as IHSS 117.3 and the soil gas surveys for both IHSSs will be performed together, the soil gas samples will also be analyzed for toluene and total xylenes.

Analyses of groundwater samples from existing well P418289 and piezometer P414189 will provide data which may be useful in assessing potential contamination associated with IHSS 117.3 (Figure 6-2). Groundwater samples from these locations will be analyzed for the constituents indicated in Table 6.4.

6.3.1.4 Oil Burn Pit No. 1 (IHSS 128)

Stage 1 sampling efforts for IHSS 128 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-6 and Table 6.3). These activities will also provide data required for the evaluation of the portion of IHSS 134 that occurs in this location (see Section 6.3.1.5). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. A 20-foot grid spacing was selected for the soil gas survey because the precise location of these IHSSs is not known and areas of contamination associated with them are likely to be relatively small. It is believed that these sites are located beneath the current location of Sage Avenue (Figure 6-6). It is anticipated that these surveys can be conducted between Sage Avenue and the drainage ditch to the south and the parking lot to the north. One sampling location will also be established on Sage Avenue near the center of these IHSSs. This sampling location will require that an access hole be cut through the pavement on Sage Avenue. It is estimated that approximately 10 feet of artificial fill was placed over these IHSSs during the construction of Sage Avenue. Therefore, the soil gas probe will be driven to a depth of 15 feet for sampling.

Because the location of the burn pit is of some question, the area of investigation will be expanded west to Fourth Street if no contaminated areas are found within the current IHSS boundary. If there are anomalous readings, the soil gas sampling will be expanded to clearly define the extent of contamination as described in the data quality objectives.

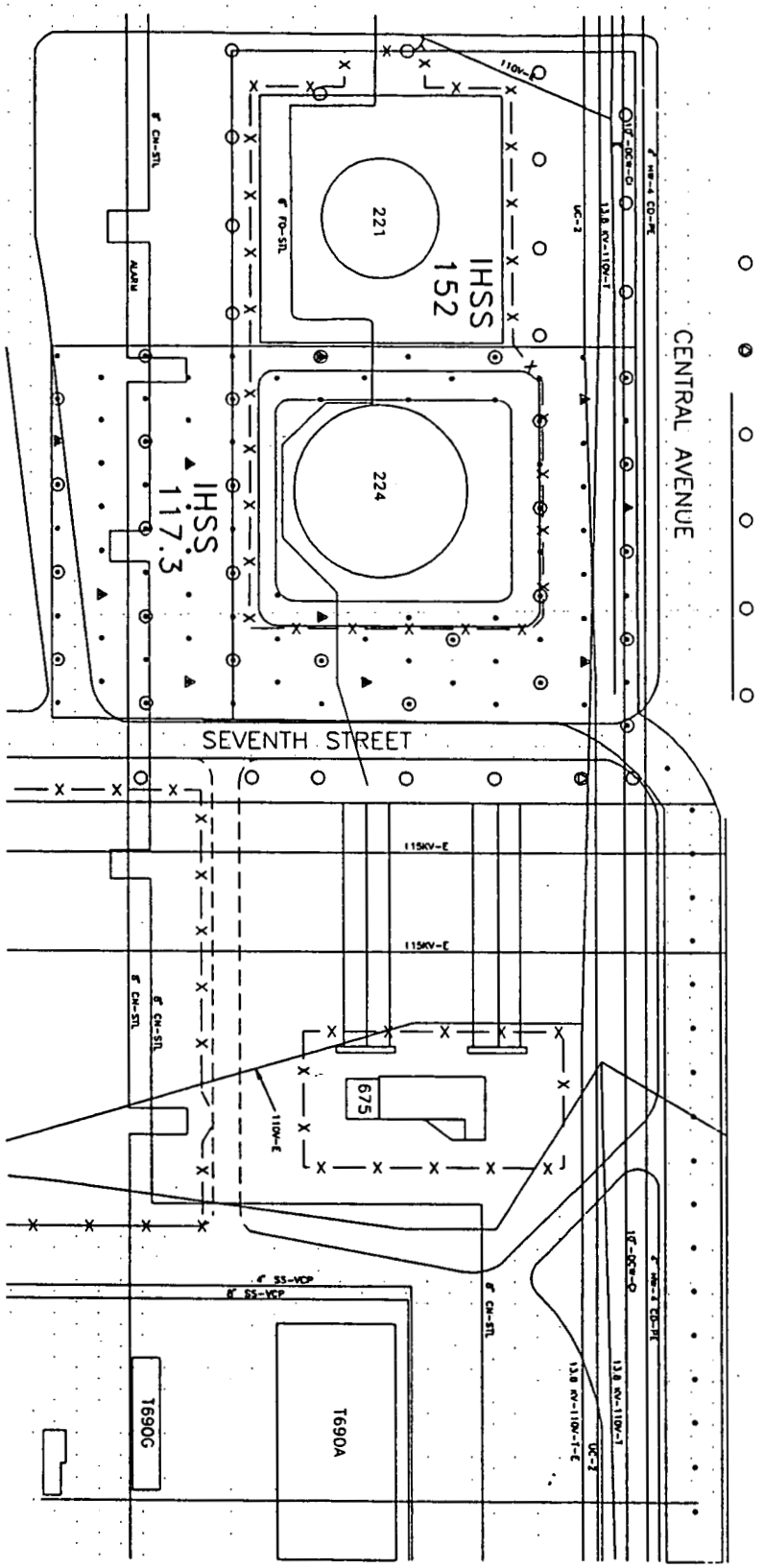

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FIGURE 6-5

IHSS SAMPLING LOCATIONS
IHSS 117.3 & IHSS 152

The surface radiological survey will be performed with an HPGe instrument. A sample of the soil present at the base of the artificial fill will be collected from within the boring drilled for the soil gas survey for analysis of radionuclides with a laboratory HPGe. The concentration of lithium and magnesium will also be measured. Subsequent to the HPGe survey, surficial soil samples will be collected from eleven locations in the combined IHSS 128, IHSS 134N and IHSS 171 area for analysis of lithium, magnesium, and TAL metals (Figure 6-6). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to confirm the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

IAG Required

benzene	toluene	xylene	perchloroethene

Indicated by Available Data

carbon disulfide	acetone

Analyses of groundwater samples from existing piezometers P114989, P114889, and P114789 will provide data which may be useful in assessing potential contamination associated with IHSS 128 and the northern portion of IHSS 134 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

6.3.1.5 Lithium Metal Destruction Site (IHSS 134)

As discussed in Section 6.3.1.4, the northern portion of IHSS 134 will be investigated with IHSS 128. Stage 1 sampling efforts for the southern portion of IHSS 134 will consist of a visual inspection, soil gas surveys, surficial soil sampling, and sampling of existing groundwater

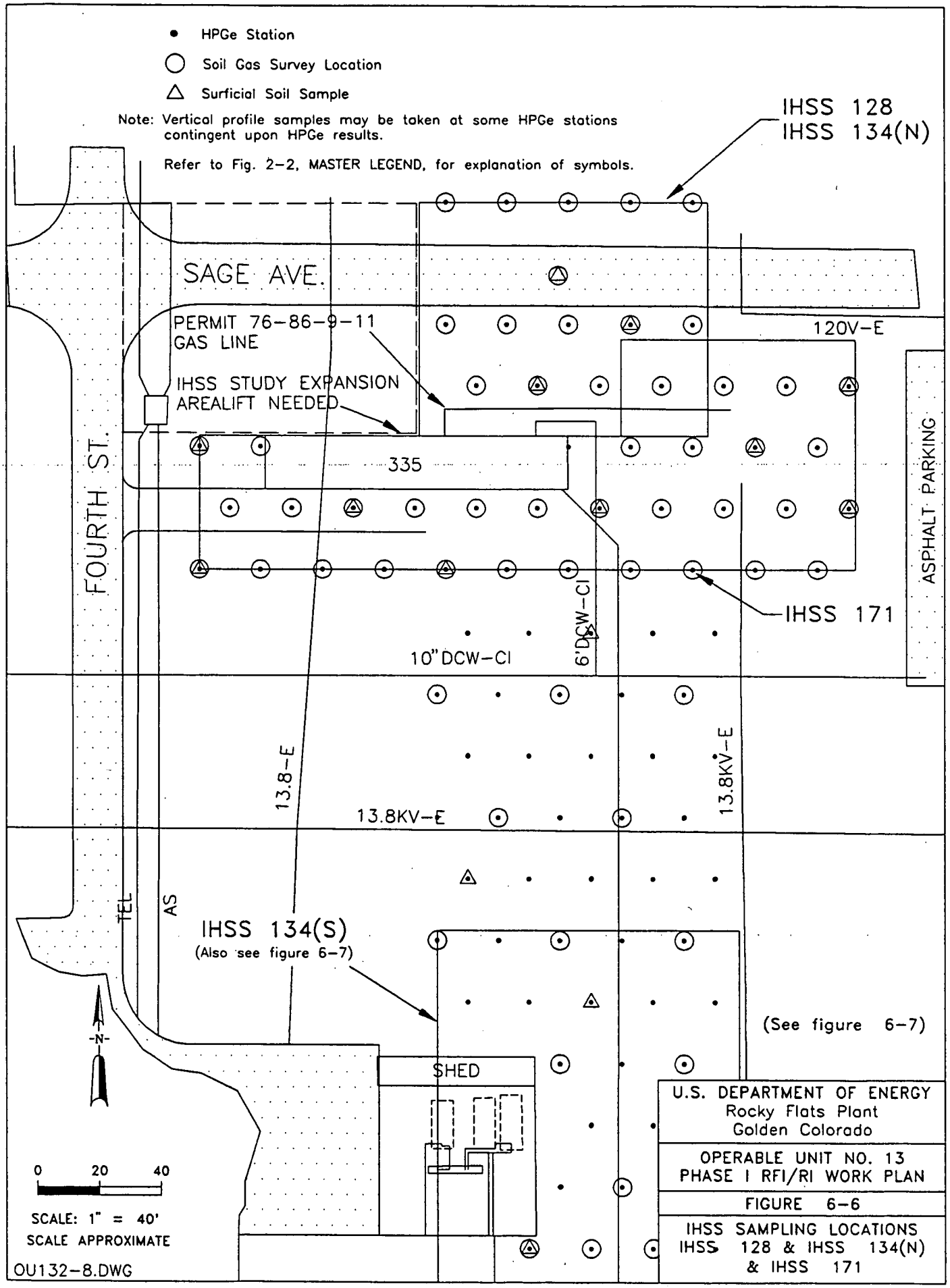
HPGe Station
Soil Gas Survey Location
Surficial Soil Sample
Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe results.
Refer to Fig. 2-2, MASTER LEGEND, for explanation of symbols.
IHSS 128
IHSS 134(N)
SAGE AVE.
PERMIT 76-86-9-11
GAS LINE
IHSS STUDY EXPANSION
AREALIFT NEEDED
120V-E
335
FOURTH ST.
ASPHALT PARKING
IHSS 171
6"DCW-CI
10"DCW-CI
13.8-E
13.8KV-E
13.8KV-E
TEL
AS
IHSS 134(S)
(Also see figure 6-7)
(See figure 6-7)
SHED
N
0 20 40
SCALE: 1" = 40'
SCALE APPROXIMATE
OU132-8.DWG
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FIGURE 6-6
IHSS SAMPLING LOCATIONS
IHSS 128 & IHSS 134(N)
& IHSS 171

monitoring wells and piezometers (Figure 6-7 and Table 6.3). The available information regarding releases at this IHSS indicates that these releases occurred both before and after portions of the IHSS were paved. Thus, the investigation of this IHSS will focus on potential contamination of the asphalt as well as the soils beneath the asphalt. The surveys will be conducted, as possible, from the eastern addition of Building 331 north to IHSS 171 near Building 335 and from Building 331 east to the 334 parking area (Figures 6-6 and 6-7). The soil gas survey of this IHSS will be performed on a triangular grid spacing of 20 feet from Building 331 to approximately 100 ft north of Building 331 and then will use a 40-foot spacing northward to the IHSS 171 boundary. The tighter grid spacing was selected for the area near Building 331 because most of the releases associated with this IHSS were believed to have occurred near Building 331. It is likely that the surveys of this IHSS will be performed in conjunction with the surveys of IHSS 171 (see Section 6.3.1.10). Those portions of this area that are paved will require that access holes be cut through the pavement prior to initiating investigations of potential contamination of the soils beneath the pavement.

Surficial soil samples will be collected from eleven locations in IHSS 134S and the area up to the IHSS 171 boundary for analysis of TAL metals, and lithium (Figure 6-7).

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

IAG Required

benzene toluene xylene

Indicated by Available Data

carbon disulfide acetone

Analyses of groundwater samples from existing piezometer P115489 will provide data which may be useful in assessing potential contamination associated with IHSS 122 (Figure 6-2). Groundwater samples from this piezometer will be analyzed for the constituents indicated in Table 6.4.

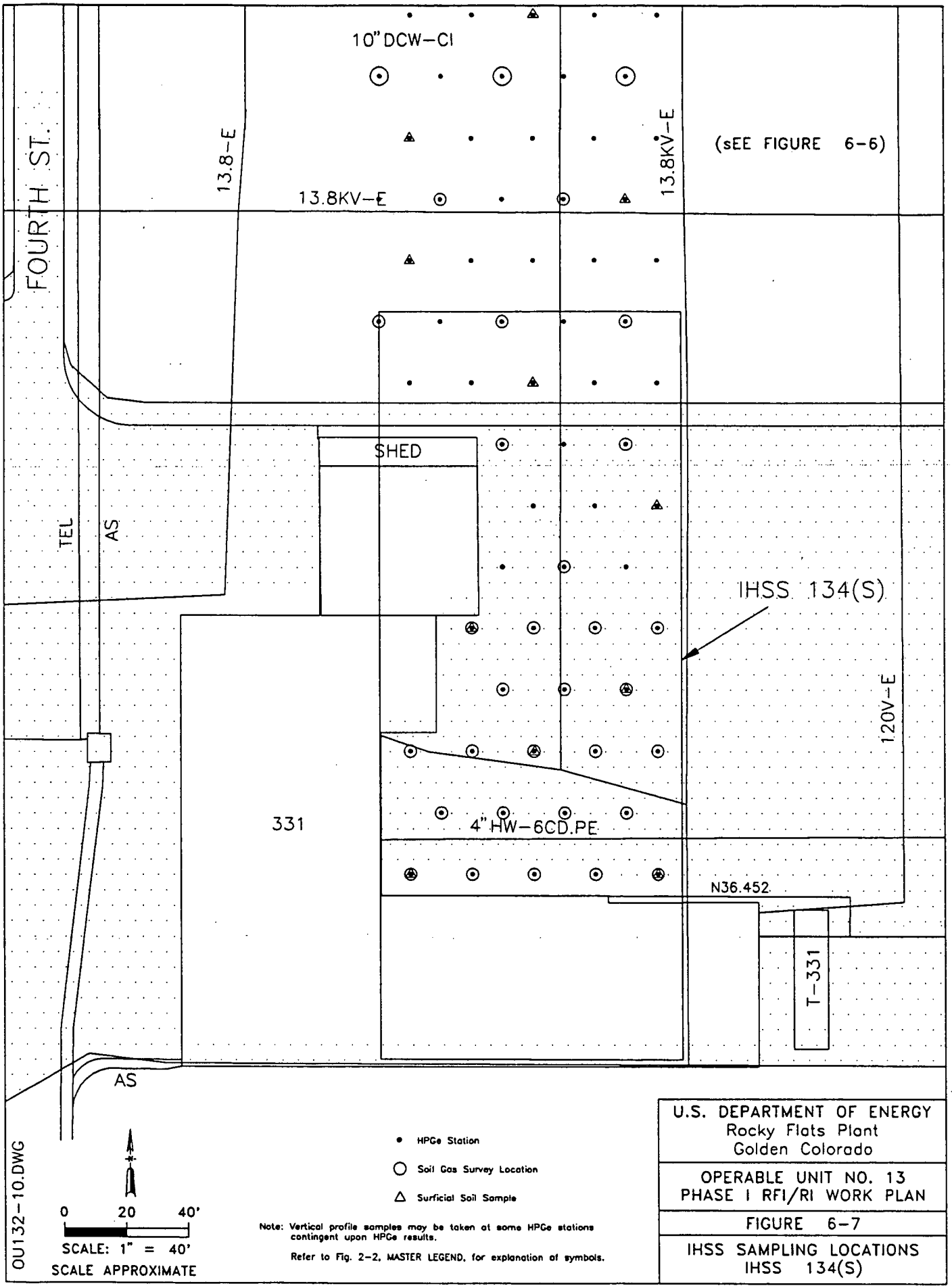
10" DCW-CI
FOURTH ST.
13.8-E
13.8KV-E
13.8KV-E
(sEE FIGURE 6-6)
SHED
TEL
AS
IHSS 134(S)
120V-E
331
4" HW-6CD.PE
N36.452
T-331
AS
OU132-10.DWG
0 20 40'
SCALE: 1" = 40'
SCALE APPROXIMATE
HPGe Station
Soil Gas Survey Location
Surficial Soil Sample
Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe results.
Refer to Fig. 2-2, MASTER LEGEND, for explanation of symbols.
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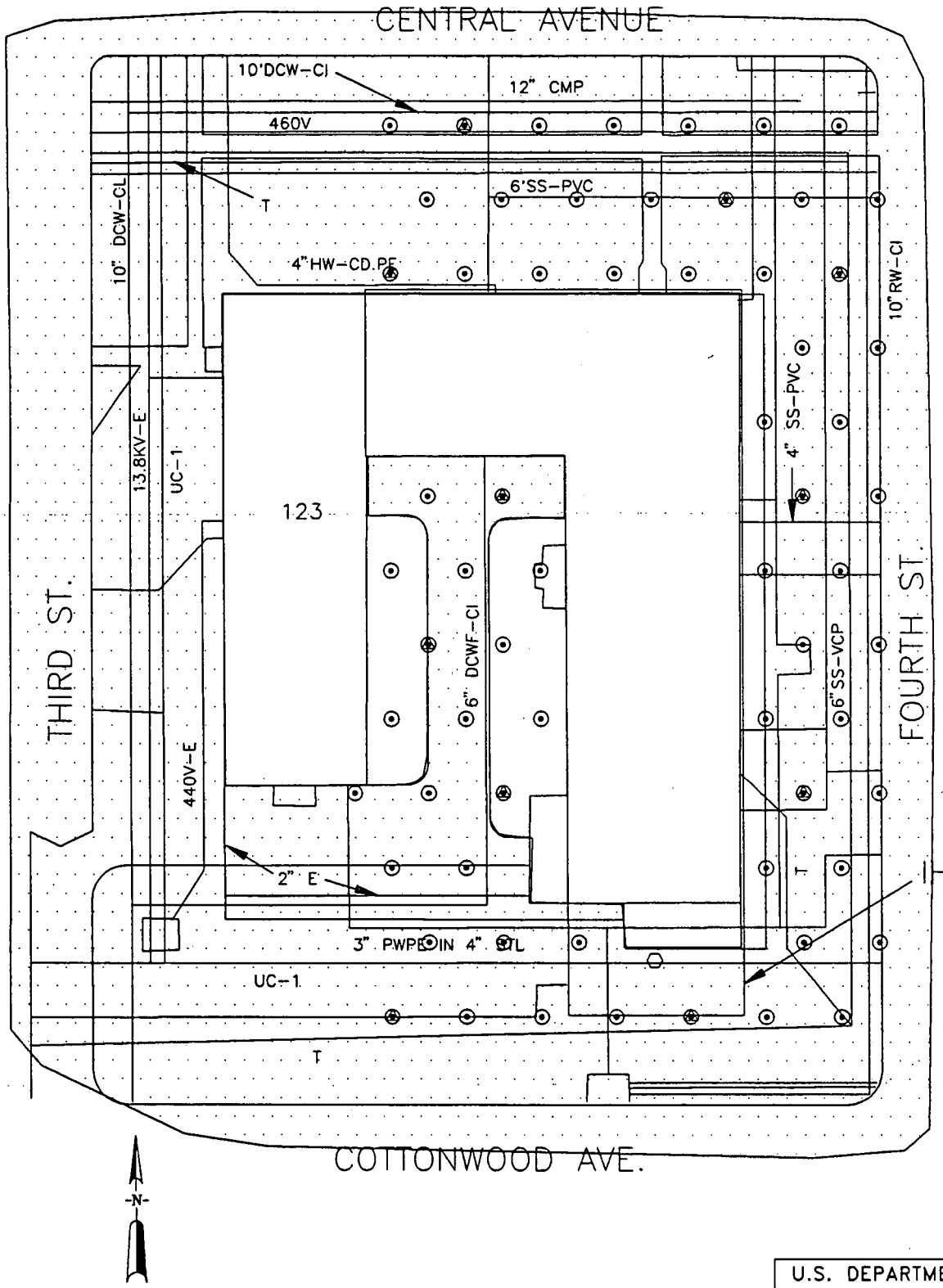
FIGURE 6-7
IHSS SAMPLING LOCATIONS
IHSS 134(S)

6.3.1.6 Waste Spills (IHSS 148)

Stage 1 sampling efforts for IHSS 148 will consist of a visual inspection, surface radiological and soil gas surveys, one soil boring, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-8 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on initial grid spacings of 20 feet. It is believed that the releases that may have occurred within this IHSS occurred primarily beneath Building 123. The available information regarding releases at this IHSS also indicate that releases may have occurred around the building perimeter before and after the area south of the building was paved. Thus, the investigation in the paved areas surrounding the building to the north, east and south will focus on potential contamination of the asphalt as well as the soils beneath the asphalt. The surface radiological and soil gas surveys will be performed around the north, east and south perimeters to a line parallel with the eastern extension of the west wing of this building. The surveys will be performed between Building 123 and Fourth Street to the east, Central Avenue to the north, and Third Street to the west. The southern side of Building 123 will be surveyed within an area extending from the building to approximately 20 feet south of the eastern wing of the building. This area includes the alcove between the wings of the building (Figure 6-8). Much of this area is paved and will require that access holes be cut through the pavement prior to initiating the investigations of potential contamination in the soils beneath the pavement.

The surface radiological survey will initially be performed with a tripod-mounted HPGe instrument over the entire IHSS area. After the results of this survey have been evaluated, samples of asphalt will be collected at a maximum of four anomalous areas detected by this survey. These samples will be analyzed with a laboratory HPGe. At eleven locations surficial soil samples will also be collected for analysis of radionuclides, TAL metals, and beryllium (Figure 6-8). Two of these samples will be split and analyzed with a laboratory HPGe. Depending on the results of the HPGe survey, vertical profile samples may also be collected.



0 20 40

SCALE: 1" = 40'
SCALE APPROXIMATE

- HPGe Station
- Soil Gas Survey Location
- Surficial Soil Sample
- Borehole Location

Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe results.

Refer to Fig. 2-2, MASTER LEGEND, for explanation of symbols.

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FIGURE 6-8

IHSS SAMPLING LOCATIONS
IHSS 148

The IAG does not require the performance of a soil gas survey at IHSS 148. However, the available analytical data for well 4486, the nearest downgradient will to IHSS 148, indicate the presence of several VOCs in groundwater in the area. The source of these contaminants is not known, thus necessitating further investigation. The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

1,1,1-trichloroethane	perchloroethene	trichloroethene chloroform
1,1-dichloroethane	acetone	

One soil boring will be drilled adjacent to the OPWL where it exits the south side of Building 123 (Figure 6-8). The invert elevation of the pipe at this point is approximately 2.5 feet below the ground surface. The location of the pipe will be determined by examining building engineering drawings, surface geophysics, or by hand trenching along the south edge of the building. The boring will be drilled to bedrock and discrete samples will be taken as shown in Figure 6-11 and analyzed for TAL metals, beryllium, radionuclides, nitrate, chloride, and sulfate (Table 6.4).

Analyses of groundwater samples from existing well 4486 and piezometers P415989, P416189, P115589, and P115689 will provide data which may be useful in assessing potential contamination associated with IHSS 148 (Figure 6-2). Groundwater samples from these locations will be analyzed for the constituents indicated in Table 6.4.

6.3.1.7 Fuel Oil Tank (IHSS 152)

Stage 1 sampling efforts for IHSS 152 will consist of a visual inspection, a soil gas survey and sampling of existing groundwater monitoring wells and piezometers (Figure 6-5 and Table 6.3). Because the releases known to have occurred within this IHSS are relatively large (i.e., hundreds of gallons), the Stage 1 soil gas survey for this IHSS will be performed on a triangular grid spacing of 40 feet (Figure 6-5). This survey will be conducted over the entire area of the IHSS to the extent possible. The presence of Tank 221 and equipment associated with the tank may prevent the performance of this survey over a portion of the IHSS within the berm for that tank (Figure 6-5). IHSS 117.3 is located within the eastern portion of this IHSS, and the soil gas surveys for

both IHSSs will be performed at the same time. The survey will be performed over an area bounded by Central Avenue on the north, Sixth Street on the west, Seventh Street to the east, and Cottonwood Avenue to the south. IHSS 117.2 is located downgradient of IHSS 152. The soil gas survey proposed for IHSS 117.2 will also analyze for the compounds of interest to IHSS 152 and will provide information regarding the possible presence of contamination attributable to IHSS 152. One line of soil gas probes will also be placed between Central Avenue and Building 551 and IHSS 117.2 to the north and between Seventh Street and the electrical transformers to the east. Any further extension of the soil gas survey immediately downgradient of IHSS 152 is not feasible due to the presence of buildings and utilities. If the soil gas survey detects any contamination at the boundary of the IHSS, additional sample points will be attempted on the far side of the utilities, further downgradient.

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

benzene toluene total xylenes

This list of compounds is based upon the requirements stated in the IAG. No historical data was obtained during the preparation of this work plan to indicate that a more extensive suite of parameters is required at this IHSS.

Analyses of groundwater samples from existing well P418289 and piezometer P414189 will provide data which may be useful in assessing potential contamination associated with IHSS 152 (Figure 6-2). Groundwater samples from these locations will be analyzed for the constituents indicated in Table 6.4.

6.3.1.8 North Area Radioactive Site (IHSS 157.1)

Stage 1 sampling efforts for IHSS 157.1 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-9 and Table 6.3). The Stage 1 surface radiological and soil gas

surveys for this IHSS will be performed on triangular grid spacings of 20 feet. The 20-foot spacing for the soil gas surveys was selected because releases associated with this IHSS are believed to be relatively small. The available information regarding releases at this IHSS indicates that these releases occurred prior to the area south of Building 442 being paved. Thus, the investigation of this IHSS will focus on potential contamination of the soils beneath the pavement. The surface radiological and soil gas surveys will be performed around the perimeter of Building 442 to the extent possible. These surveys will be conducted in an area between the building and Central Avenue on the north, the sidewalk to the east, Fifth Street to the west, and extending approximately 40 feet to the south of the building in the area of Building 442 Driveway (Figure 6-9). Much of this area is paved and will require that access holes be cut through the pavement prior to initiating these surveys.

The surface radiological survey will be performed with an HPGe instrument. Subsequent to the HPGe survey, surficial soil samples will be collected from eleven locations for analysis of TAL metals (Figure 6-9). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to confirm the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The IAG does not require the performance of a soil gas survey at IHSS 157.1. However, the available analytical data for well 4486, located in the northwest corner of the IHSS, indicate the presence of several VOCs in groundwater in the area. The source of these contaminants is not known, thus necessitating further investigation. The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

1,1,1-trichloroethane	perchloroethene	trichloroethene chloroform
1,1-dichloroethane	acetone	

Analyses of groundwater samples from existing well 4486 and piezometers P115589 and P115689 will provide data which may be useful in assessing potential contamination associated with

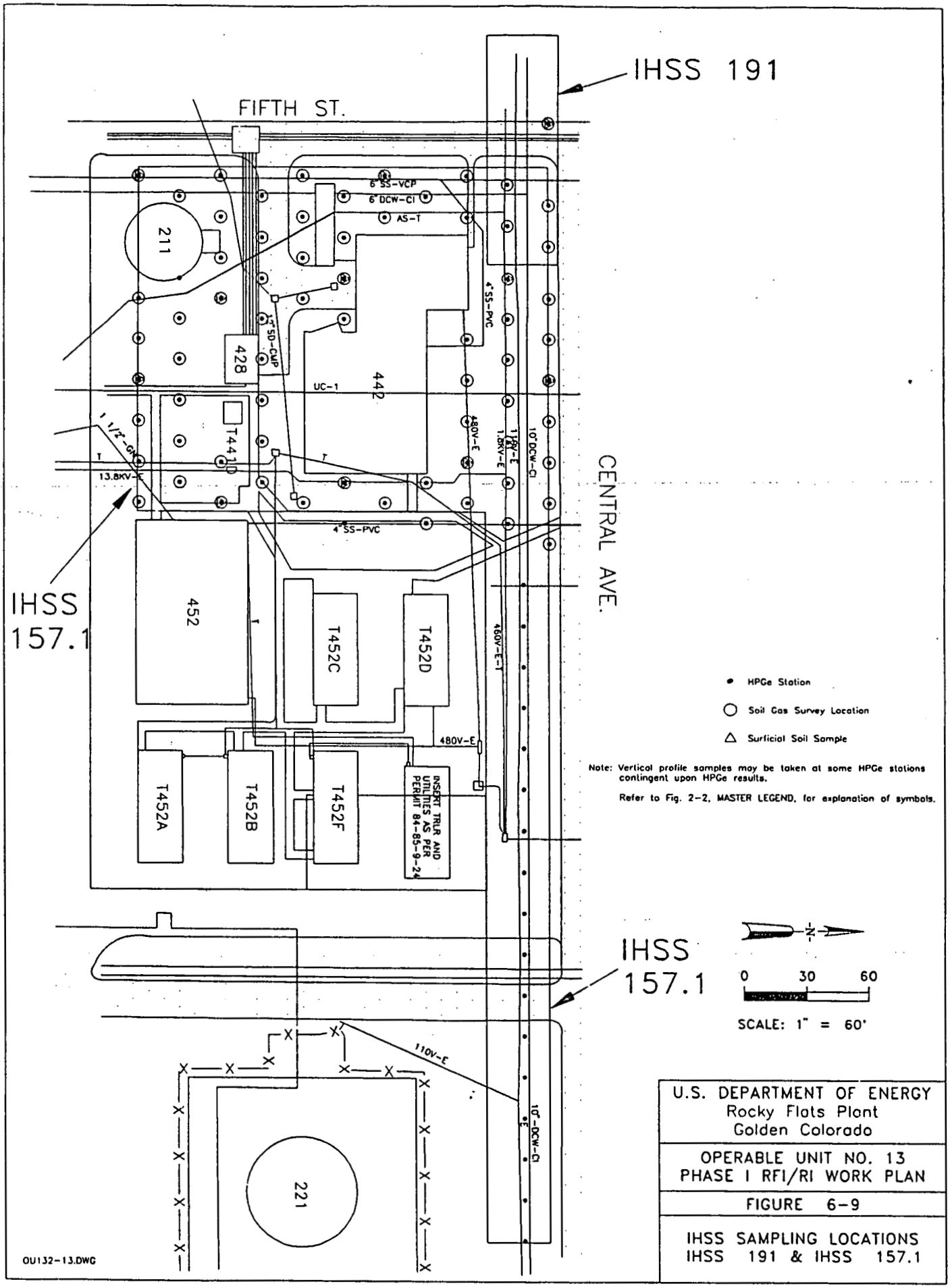

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FIGURE 6-9
IHSS SAMPLING LOCATIONS IHSS 191 & IHSS 157.1

IHSS 157.1 (Figure 6-2). Groundwater samples from these locations will be analyzed for the constituents indicated in Table 6.4.

Samples of sediments and surface water in the Central Avenue ditch (portions of this IHSS) will be taken as part of the Integrated Surface Water and Sediment Field Sampling Plan which was conceptually approved in the OU 12 Work Plan.

6.3.1.9 Building 551 Radioactive Site (IHSS 158)

Stage 1 sampling efforts for IHSS 158 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-4 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. The grid spacing for the soil gas survey was selected because the spills and other releases associated with this IHSS are believed to be relatively small. The available information regarding releases at this IHSS indicate that these releases occurred prior to the area surrounding Building 551 being paved. Thus, the investigation of this IHSS will focus on potential contamination of soils beneath the pavement. Much of this IHSS is located beneath the northern addition of Building 551. These investigations will be conducted around the perimeter of the building to the extent possible. The area to be investigated will consist approximately of the area outside of the foundation of Building 551 from the junction between the original building and the northern addition north to Sage Avenue and from Sixth Avenue on the west side of the building to IHSS 117.2 east of the building (Figure 6-4). Much of the area north and east of the building is paved and will require holes cut through the pavement prior to initiating these surveys. In addition, the presence of several trailers and loading docks on the western side of the building necessitate that the survey grids be adjusted to maximize the coverage of the surveys in those areas.

The surface radiological survey will be performed with a tripod-mounted HPGe. Subsequent to the HPGe survey, surficial soil samples will be collected from eleven locations in the combined IHSS 117.2 and IHSS 158 area for analysis of TAL metals and radionuclides (Figure 6-4). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides

with a laboratory HPGe to confirm the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

IAG Required

1,1,1-trichloroethane	perchloroethene	acetone	trichloroethene	
toluene	benzene	carbon tetrachloride		

Indicated by Available Data

ethylbenzene	2-butanone	carbon disulfide	dichloromethane	total xylenes

Analyses of groundwater samples from existing piezometers P115589, P115689, P214689, and P215789 will provide data which may be useful in assessing potential contamination associated with IHSS 158 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

6.3.1.10 Waste Drum Peroxide Burial (IHSS 169)

As discussed in Sections 2.2.1.10 and 6.3, the documentation obtained during the preparation of this work plan indicates that the release described as IHSS 169 did not occur in the location previously indicated but is the same as IHSS 191. Regardless of the location of this incident, it is not likely that there would be detectable impacts attributable to it. Therefore, no further investigation of IHSS 169 is proposed.

6.3.1.11 Solvent Burning Ground (IHSS 171)

Stage 1 sampling efforts for IHSS 171 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, sampling of the sump within the IHSS, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-6 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. The grid spacing selected for the soil gas survey is based upon the relatively small size of areas of contamination expected to be associated with this IHSS. The area to be investigated will extend from Fourth Street east to the driveway to Building 331 and from Sage Avenue south approximately 100 feet to the base of a small slope to connect with the investigations of the southern portion of IHSS 134 (see Section 6.3.1.5). The surface of this area has not been paved and should not pose significant problems to the performance of these investigations.

The surface radiological survey will be performed with a tripod-mounted HPGe instrument over the entire area. Subsequent to the HPGe survey, surficial soil samples will be collected from eleven locations in the combined IHSS 134N, IHSS 128 and IHSS 171 area for analysis of radionuclides, lithium, and magnesium (Figure 6-6). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to confirm the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

IAG Required

1,2-dichloroethane	perchloroethene	trichloroethene chloroform
carbon tetrachloride	methylene chloride	

Indicated by Available Data

carbon disulfide acetone

As discussed in Section 2.1.1.11, an open sump located within IHSS 171 has contained standing water with an oily sheen on its surface during several site visits from November 1991 to March 1992. If water is present in the sump, the water will be sampled and analyzed for TCL volatiles and semivolatiles, TAL metals, and radionuclides (Table 6.4).

Analyses of groundwater samples from existing piezometers P114989, P114889, and P114789 will provide data which may be useful in assessing potential contamination associated with IHSS 171 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

6.3.1.12 Valve Vault (IHSS 186)

Stage 1 sampling efforts for IHSS 186 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, two soil borings, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-10 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. Although the area potentially affected by the releases associated with this IHSS was relatively large, considerable excavation of soils in the area has occurred in response to these releases. Thus, the remaining contamination, if it occurs, may occur in smaller areas necessitating the smaller grid spacing selected for the soil gas survey. The area to be surveyed will extend from the Protected Area south to Valve Vault 13 and then east to connect with IHSS 117.1 (Figure 6-10). The area to be surveyed is unpaved and should not pose significant problems to the performance of these surveys with the exception of adjustments in grid spacing to account for the valve vault, Building 231, and utilities in the area. The portion of this IHSS that extends into the area covered by IHSS 117.1 will be surveyed, both surface radiological and soil gas, under the planned program for IHSS 117.1 (Section 6.3.1.1). The Stage 1 investigation of IHSS 186 will not extend into the Protected Area. If the results of Stage 1 indicate that sampling within the Protected Area is

necessary, a sampling program will be developed for implementation during Stage 2, or that portion of the IHSS will be transferred into a Protected Area investigation.

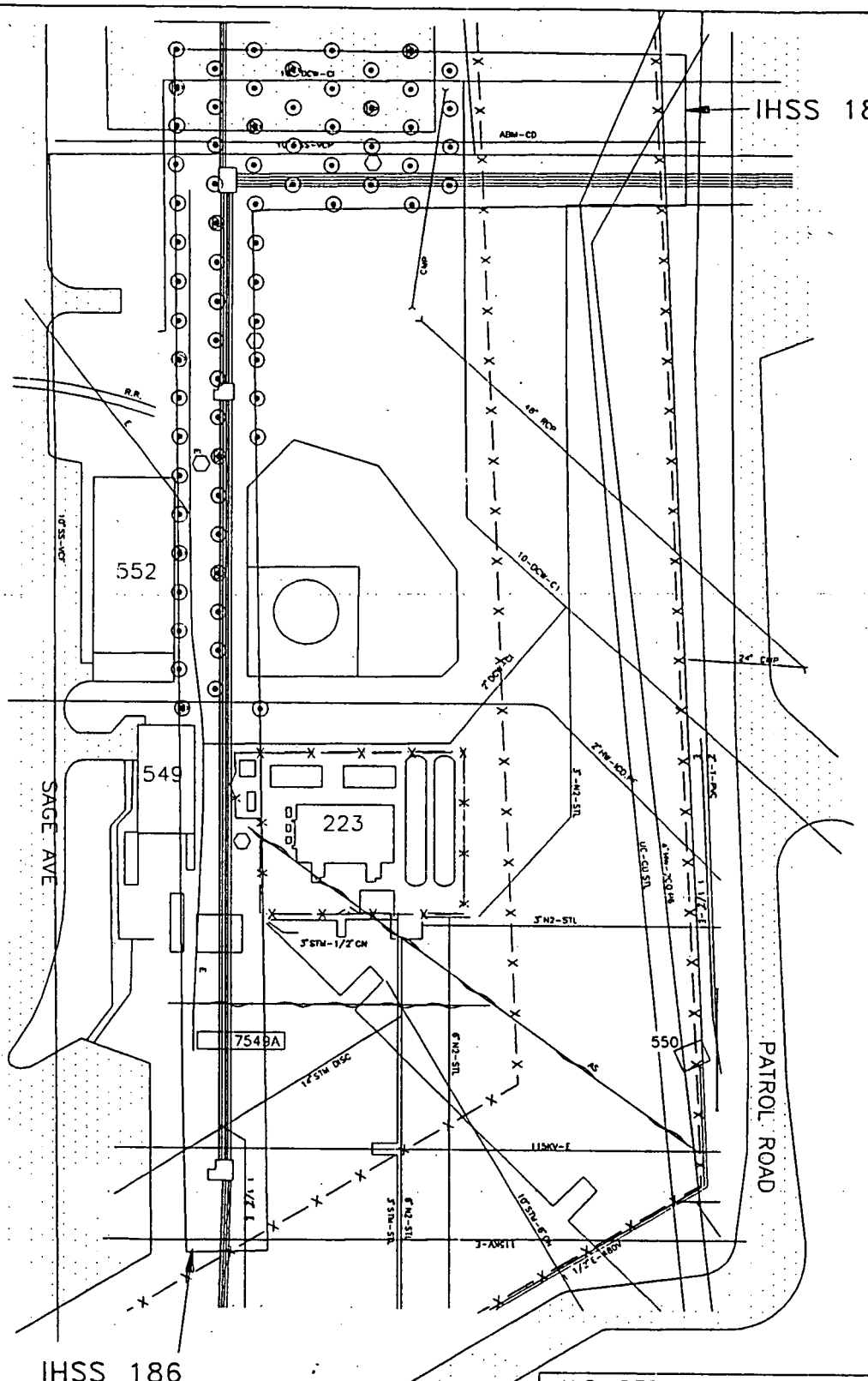
The surface radiological survey will be performed with a tripod-mounted HPGe instrument over the entire area. At eleven locations, a surficial soil sample will also be collected for analysis of radionuclides and TAL metals (Figure 6-10). Two of these samples will be split and sent for laboratory HPGe analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

Soil borings will be located and drilled to bedrock. Sampling intervals are displayed in Figure 6-11.

The IAG does not require the performance of a soil gas survey at IHSS 186. However, the available analytical data for well P114789, located near the southern edge of the IHSS, indicate the presence of several VOCs in soils in the area. The source of these contaminants is not known, thus necessitating further investigation. The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

benzene	carbon disulfide	ethylbenzene	toluene
total xylenes	acetone		

Two soil borings will be drilled adjacent to the process waste lines in the area believed to have been contaminated by releases around Valve Vault 12 (Figure 6-10). One boring will be located between Valve Vault 12 and the retaining wall around Tanks 231A and 231B where the 1986 release was first detected. The other boring will be located approximately 18 feet west of the valve vault near the edge of an area believed to have been excavated in response to the 1986 release. Additional borings during Stage 2 will be placed between Valve Vault 13 and the Protected Area and east of Valve Vault 12 between Buildings 223 and 549. All borings will be drilled to bedrock. Each boring will be sampled in accordance with the specifications provided in Section 6.3.2 for Stage 2 borings with the following exceptions. Composited samples will also be analyzed for



SOIL GAS & SURFACE RADIOLOGICAL SURVEY WILL BE DONE AS PART OF IHSS 117.1 SURVEY

- HPGe Station
- Soil Gas Survey Location
- Surficial Soil Sample
- Borehole Location

Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe results.

Refer to Fig. 2-2, MASTER LEGEND, for explanation of symbols.

0 40 80

SCALE: 1" = 80'

SCALE APPROXIMATE

OU132-17.DWG

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden Colorado

OPERABLE UNIT NO. 13
PHASE I RFI/RI WORK PLAN

FIGURE 6-10

IHSS SAMPLING LOCATIONS
IHSS 186

nitrate. Analysis of radionuclides in samples from these borings will be performed onsite with a laboratory HPGe.

Analyses of groundwater samples from existing piezometers P114789 and P214689 will provide data which may be useful in assessing potential contamination associated with IHSS 186 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

6.3.1.13 Caustic Leak (IHSS 190)

As discussed in Sections 2.2.13 and 6.3, it is unlikely that any impact attributable to releases within this IHSS would be detectable. Therefore, the only investigation of this IHSS proposed in this Work Plan, is that the Central Avenue Ditch, which is included in a portion of this IHSS, will be investigated within the Integrated Surface Water and Sediment Field Sampling Plan described in the OU 12 Work Plan. This plan will be incorporated into the Work Plan for Operable Unit No. 12 as a technical memorandum. Results from investigations outlined in the Integrated Surface Water and Sediment Field Sampling Plan will be addressed in the technical memorandum prepared at the end of Stage 2, and the results will be incorporated into the OU 13 RFI/RI report.

6.3.1.14 Hydrogen Peroxide Spill (IHSS 191)

As discussed in Sections 2.2.14 and 6.3, it is not likely that there would be detectable impacts attributable to the release of hydrogen peroxide within this IHSS. Therefore, no further investigation of this IHSS is proposed.

6.3.1.15 HRR PACs and PICs

This section reflects the incorporation of investigations arising from the information presented in the HRR (July 1992).

100-602, 100-603— These areas are clearly within OU 13 IHSS #148. Section 6.3.1.6 already identifies several field activities that will provide substantial information about these areas. These include surface radiological analysis with the HPGe, soil gas analysis for VOCs, and a soil boring adjacent to the Old Process Waste Line (OPWL) where it exits the south side of the building. Discrete samples will be taken at specified depths (see Figure 6-11) for analysis. Analytes will include TAL metals, radionuclides, nitrates, chlorides, and sulfates. If contaminates are found a second stage of sampling will be proposed in a Technical Memorandum (TM) to determine the nature and extent of the contamination.

100-611— This area is the site of a spill of several hundred gallons of acid scrubbing solution which was reported to have spilled into a containment area and 3 pits beneath Building 123. Because the spill occurred beneath the building and there is no direct evidence to support the contention that the leak may not have been contained as described in the HRR, no further Stage 1 investigations are planned. However, if Stage 1 investigations indicate that the area around the foundation of the building needs further investigation, addition soil borings will be scheduled in Stage 2 or 3.

100-607, 100-608, 300-709, 400-800, 500-904— These are reported as small leaks of PCBs from electrical transformers around the industrial area in the general vicinity of OU 13. Only 500-904 is actually in an OU 13 IHSS -- IHSS 117.1. All of these PCBs locations are well documented in EG&G Rocky Flats Environmental Management Department Assessment of Potential Environmental Releases of Polychlorinated Biphenyls (PCBs) July 1991. These are currently outside the scope of the present work plan and IAG. Further investigation will require substantial resources. Those PCB locations not associated with a current OU 13 IHSS will be addressed as part of a sitewide PCB remediation strategy.

Because the location of the contamination at PCB location 500-904 is known and is located within IHSS 117.1, the next step in the process will be to define the nature and extent of the contamination. The information presented in the above referenced report will be reviewed and the findings incorporated into Technical Memorandum 1 to outline appropriate activities in Stage 2.

100-609—Possible releases of dioxins and furans from the Security Incinerator in Building 123. It is likely that if there were generation of dioxins and furans from the combustion of No Carbon Required (NCR) paper, that these contaminants were released as smoke (i.e. aerosol sized particles) and are not likely to be found in detectable quantities down wind of the incineration point. If the incinerator is still intact in Building 123, an effort will be made to confirm or refute the sampling that took place in 1985. If no results can be obtained, then sampling could be either incorporated into the Decontamination & Decommissioning Plan for that building or incorporated into Stage 2. In either case the search for the data will be a Stage I activity and the results of that search reported in the Technical Memorandum.

300-702—A small building NW of the T371 complex used to store pesticides and herbicides from 1952 until 1985. Not enough information is presented in the HRR to cause this site to become an IHSS. Further investigations will be conducted as part of the Integrated Field Sampling Program for Sediments and Surface Water described in the OU 12 Work Plan. Confirmation of the possible soils contamination will be performed if the 1988 sampling records can not be found. A few sediment samples taken from the ditches near the site would be sufficient to determine if the contamination (if present) poses any human health risk. An exact number of samples and a map showing the location of the sampling points will be included in the Integrated Surface Water and Sediment Field Sampling Program and the results reported in the appropriate Technical Memorandum.

PIC #9—Possible contamination of the ground near Building 551 with aqueous ammonia and carbon tetrachloride. Sampling activities in IHSS 158 already include soil gas investigations for carbon tetrachloride. This will be sufficient to detect any sizable spill within the area. A small aqueous ammonia spill is not likely to be detected this many years after release and would pose little, if any, risk to workers or the public at this time. Therefore the proposed sampling described in the work plan is sufficient to address concerns.

6.3.2 Stage 2 Investigation

Upon completion of Stage 1, the data collected during the screening surveys and measurement of radionuclides will be evaluated and presented in a technical memorandum. This technical memorandum will provide the details of the Stage 2 investigation. The Stage 2 investigation will be performed to confirm the results of Stage 1 and to further define any contamination detected during Stage 1. Stage 2 will consist of the drilling of boreholes at locations indicated by Stage 1 screening surveys. Because of the turn-around time involved with obtaining results of the laboratory analyses of surficial soil samples, not all borings may be drilled during Stage 2.

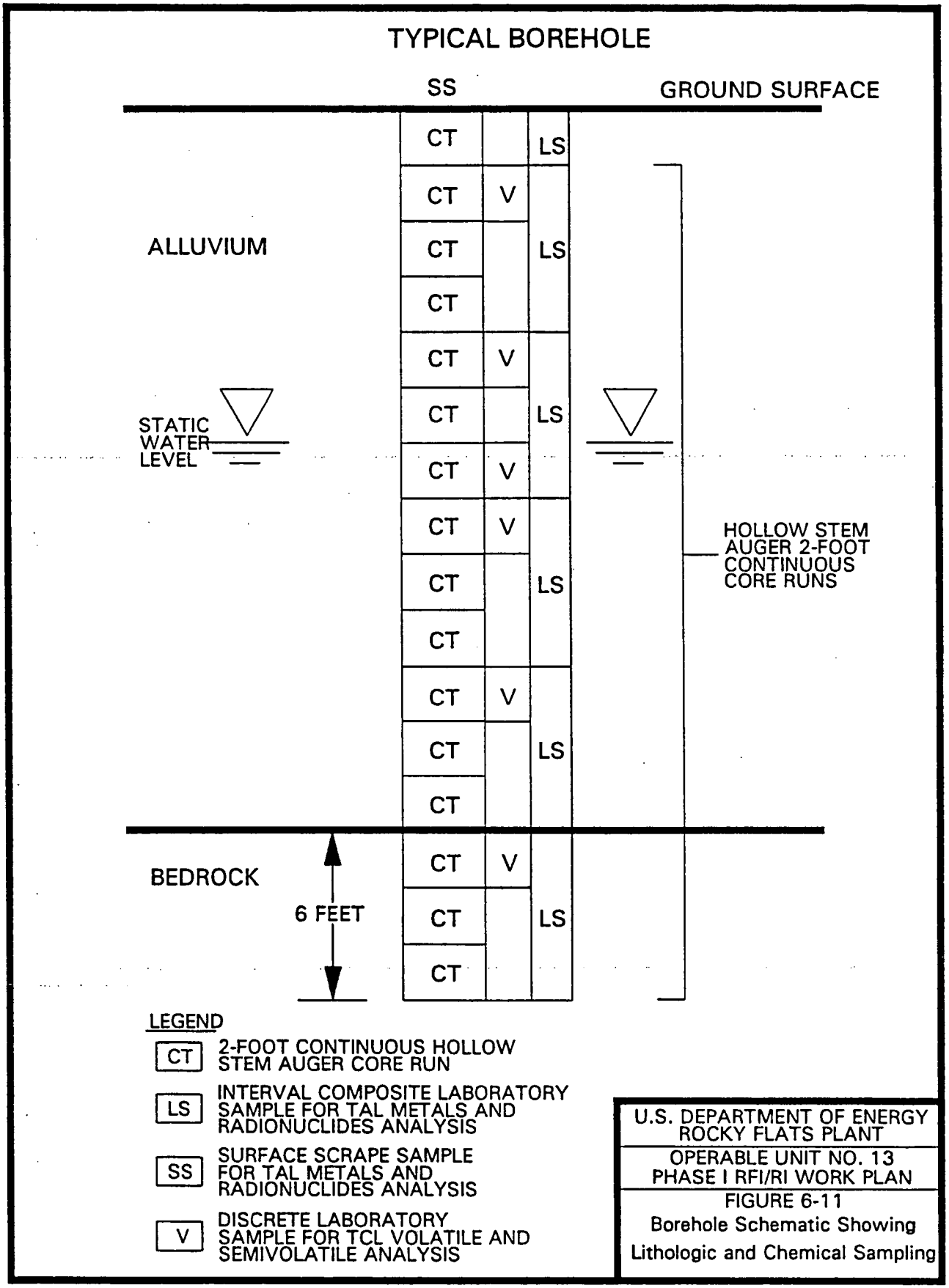
For those IHSSs where no contamination was detected by Stage 1 activities, a sufficient number of boreholes will be drilled to confirm that there is no contamination. The number of borings will be proposed in the first Technical Memorandum and will be based on IHSS size, known waste storage history, and possible below ground releases.

At IHSSs where contamination was found during the screening surveys, Stage II will consist of at least three borings transecting each anomaly (radioactive or other contaminant) downgradient from the point of maximum contamination. This will be done for a maximum of three transects resulting in nine boreholes per IHSS.

The need for any additional boreholes can be evaluated in the Stage 2 Technical Memorandum. These additional borings, if required, will be installed during Stage 3.

Three borings will be drilled around Tank 221 in IHSS 152 in order to delineate contamination that has resulted from releases that have occurred. The locations of these borings will be determined by the results of the soil gas analyses and will be presented in the technical memorandum prepared at the end of Stage 1.

All boreholes will be drilled to a depth of six feet into bedrock. If sandstone is encountered in the six foot interval, the borehole will be continued through the sandstone until at least six feet of


TYPICAL BOREHOLE
SS
GROUND SURFACE
ALLUVIUM
STATIC WATER LEVEL
BEDROCK
6 FEET
CT
V
LS
HOLLOW STEM AUGER 2-FOOT CONTINUOUS CORE RUNS
LEGEND
CT 2-FOOT CONTINUOUS HOLLOW STEM AUGER CORE RUN
LS INTERVAL COMPOSITE LABORATORY SAMPLE FOR TAL METALS AND RADIONUCLIDES ANALYSIS
SS SURFACE SCRAPE SAMPLE FOR TAL METALS AND RADIONUCLIDES ANALYSIS
V DISCRETE LABORATORY SAMPLE FOR TCL VOLATILE AND SEMIVOLATILE ANALYSIS
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT
OPERABLE UNIT NO. 13
PHASE I RFI/RI WORK PLAN
FIGURE 6-11
Borehole Schematic Showing
Lithologic and Chemical Sampling

claystone is encountered. Figure 6-11 graphically illustrates the samples that will be taken from each borehole as described in the following paragraphs.

Surface scrape samples will be taken at the location of each borehole prior to initiating drilling. These samples will be analyzed for radionuclides and TAL metals (Table 6.4). At locations that are paved, instead of collecting a surface scrape, an alternate sampling method will be used. After the pavement has been removed, a grab sample of the material under the pavement will be taken with a steel scoop. Then another grab sample will be taken at either a depth of 4" below the bottom surface of the pavement, or at the surface of the next obvious soil change, whichever comes first. This sample will be analyzed for the same constituents as surface scrapes.

In each borehole, discrete samples will be taken at specified intervals during drilling for analysis of TCL volatiles (Figure 6-11). Samples for TCL volatile analyses will also be taken at the water table and at the alluvium-bedrock contact. Composite samples will be collected in each borehole from every 6-foot interval for analysis of TCL semivolatiles, TAL metals and radionuclides. All geologic materials will be continuously logged during drilling and 5 samples of alluvium and 5 samples of bedrock will be taken from boreholes throughout OU 13 for physical analyses (Section 6.5.2). All sampling activities will conducted in accordance with EG&G SOPs (Table 6.3).

Where boreholes are being drilled at the location of the highest level of contamination detected in the Stage 1 surveys, or where otherwise identified in the Stage 1 Technical Memorandum, groundwater samples will be collected from the borehole using the Hydropunch®, or equivalent, technology. An SOP for the Hydropunch®, or equivalent, technology will be developed as part of the Field Implementation Plan, and submitted to the regulatory agencies for review. The Hydropunch® will be lowered inside the hollow stem auger and then pushed or driven to a depth of at least 5 feet below the water table, if possible. Water samples will be collected for real time analysis of TCL volatiles and laboratory analysis of TCL volatiles and semi-volatiles, TAL metals, radionuclides, and anions (Table 6.4). Field measurements of pH, temperature, and specific conductance will also be performed.

Upon completion of borehole sampling activities, all boreholes will be plugged and abandoned in accordance with EG&G SOPs (Table 6.3), unless they have been identified to be completed as an alluvial monitoring well. All access holes cut into pavement will be patched with the proper material. If it is determined that a borehole should be completed as an alluvial monitoring well for risk assessment or contaminant characterization, it will be completed at this time in accordance with EG&G SOPs (Table 6.3). Any wells installed during Stage 2 will be analyzed for the constituents specified in Table 6.4. The wells will be sampled once as part of the RFI/RI. Subsequent sampling will be conducted under EG&G's sitewide monitoring program.

Due to access problems at certain IHSSs, it may not be possible to install boreholes in the locations indicated by the Stage 1 activities. Under these circumstances alternate locations for the boreholes will be evaluated based upon the results of Stage 1. For example, based upon the present location of fuel oil Tanks 221 and 224 within bermed areas in IHSSs 152 and 117.3 it is unlikely that boreholes can be drilled inside of the berms for these tanks. If contamination is detected during Stage 1 activities at these IHSSs, boreholes will be drilled outside of the bermed areas in those locations where the greatest potential exists for detecting such contamination.

Upon the completion of Stage 2, the results of Stages 1 (including analyses of subsurface and surficial soil samples and groundwater samples) and 2 will be fully evaluated to determine if further investigation of each IHSS is necessary. If the data collected do not indicate that contamination exists at a particular IHSS, no further investigation of that IHSS will be necessary. If the borehole and groundwater data collected indicate that contamination exists at an IHSS, then the Stage 3 investigation of that IHSS will be initiated. The existence of contamination will be based on background concentrations provided in the Background Geochemical Characterization Report as described in Section 2.2 of this Work Plan. The results of Stages 1 and 2 and recommendations for further investigation will be documented in a technical memorandum. This technical memorandum will summarize the results collected and will outline the scope of the Stage 3 investigation, if necessary, for each IHSS, particularly if Stage 3 will require activities that are not described in this Work Plan. In addition, if the information obtained during Stages 1 and 2 indicates that a vadose zone monitoring program is required at any OU 13 IHSS(s), the details of this program will be included in this technical memorandum.

6.3.3 Stage 3 Investigation

The focus of the Stage 3 investigation will be to attempt to determine migration of contamination detected during Stages 1 and 2. The scope of the Stage 3 investigation is largely dependent upon the results of the Stage 1 and Stage 2 investigations. The number, location, and types of sampling points required cannot be precisely defined until Stages 1 and 2 have been completed and the data collected fully evaluated. The exact sampling locations will be determined on a case-by-case basis, taking into account the following factors:

- Environmental fate and transport of the specific contaminants;
- Contaminant concentrations;
- Expected depth to water table and bedrock;
- Nature of alluvium;
- Presence of any subcropping sandstone units in the bedrock; and
- Other pertinent data.

For scoping purposes, it is assumed that two alluvial groundwater monitoring wells will be required to be installed at each IHSS determined to be a source of contamination in Stages 1 and 2. One well upgradient and one well downgradient of these IHSSs will be installed. Whenever possible, existing wells and piezometers will be used for the Stage 3 investigation. Figure 6-12 provides preliminary locations of new wells to be installed and identifies those existing wells or piezometers that may be used during Stage 3. These locations will likely change based on the results of the Stage 1 and Stage 2 investigations and due to access problems. Based on the preliminary well locations identified in Figure 6-12, it is estimated that a maximum of 17 new wells will be installed during Stage 3. It is also estimated that a maximum of 10 existing wells and piezometers will be sampled during Stage 3. The final numbers and locations of wells to be installed will be specified in the technical memorandum prepared at the end of Stage 2. As discussed in Section 6.3.2, additional borings may be required in Stage 3. The need for and locations of these borings will be specified in the technical memorandum.

During the drilling of new wells, borehole samples will be collected for analysis. The intervals sampled and the analytes for each sample will be the same as those defined above for Stage 2 (Table 6.4). If the Stage 1 and Stage 2 investigations indicate that a less extensive list of analytes will be required at any location, the analytes for samples obtained at that location will be specified in the technical memorandum submitted at the completion of Stage 2.

Groundwater samples will be collected from each well and analyzed for the list of constituents identified in Table 6.4. As with borehole samples, if a less extensive suite of analytes is required, the analytes for groundwater samples will be specified in the technical memorandum submitted at the completion of Stage 2. Samples will be collected from each new well immediately upon completion. Samples from existing wells and piezometers will be collected once at the time the Stage 3 investigation is initiated. Subsequent groundwater sampling will be performed as part of the site-wide monitoring program and will be arranged for by EG&G.

6.4 SAMPLING EQUIPMENT AND PROCEDURES

The following sections describe the sampling equipment and procedures to be followed in general terms. Details regarding each of the sampling procedures is provided in the SOPs referenced in the following sections and listed in Table 6.3.

6.4.1 Radiological Survey Procedure

Sampling locations are IHSS-specific and are discussed in Section 6.3. Radiological surveys will be conducted on 20-ft grids at all OU 13 IHSSs requiring such surveys unless visual inspection reveals that a larger grid size can provide 100 percent coverage of the investigation area. The established grids will provide approximately 100 percent coverage of the IHSS surface area. The HPGe has a broad energy range, exhibits high resolution, excellent gain stability, moderate area averaging, and the ability to identify and quantify all gamma- emitting radionuclides. The HPGe detector provides radionuclide concentrations in soil in picoCuries per gram (pCi/g) of gamma-emitting radionuclides including, but not limited to, potassium-40, radium-226, thorium-232, cesium-137, americium-241, plutonium-239, -240, and -241, and uranium-233, -234, -235,

and -238. Tritium and strontium-90 are not detected using this method. The SOP for the HPGe is presently being finalized and will be available prior to any OU 13 field work. Other equipment requirements are listed in Section 5.2 of SOP FO.16

An additional component of the radiological survey described above includes real time measurement of radionuclide concentrations in surficial soils and in vertical profile samples using a laboratory HPGe detector. Surficial soils and vertical profile samples collected via procedures in Section 6.4.3 will be surveyed with a laboratory detector to obtain radionuclide concentrations. The samples will be held for 30 days in a closed container to allow radon gas to equilibrate with parent radionuclides present in the soil. After the 30-day period, the radon activity measured will be representative of radionuclides, particularly radium, present in the soil sample.

At IHSSs where radionuclide concentrations in the soil beneath pavement are of interest, the surfacing materials block most of the gamma ray emissions associated with the source below the pavement. It is likely, however, that if the source was highly radioactive, a radioactive anomaly should be detectable. Therefore, two methods of investigation will help insure that those areas are identified. First, results will be carefully evaluated. Then a few random asphalt samples will be taken to compare with the HPGe readings. The asphalt samples will be taken with a plug type corer and measured with either standard radiochemical analysis or with an onsite laboratory HPGe instrument. The SOPs for both the asphalt sampling and analysis and the laboratory HPGe instrument are currently being developed. They will be submitted to the regulatory agencies for approval prior to use in the field.

The second method is to take a soil sample as part of the surficial soils sampling plan from below the pavement and have it analyzed for radionuclides. The procedure for sampling below the pavement is currently being revised and will be submitted to the agencies for their approval prior to using the procedure in the field. Basically, the pavement will be removed and a grab sample will be taken of the material directly below the pavement. After that sample is taken, another grab sample will be taken from the surface of the next obvious soil horizon (roadbase or preparation) bed (soil interface), or 4 inches below the bottom surface of the pavement, whichever occurs first.

6.4.2 Soil Gas Survey

Real time soil gas sampling will be conducted at specific OU 13 IHSSs presented in Section 6.3 according to procedures in SOP GT.9. Soil gas samples will be collected through a 1-inch diameter stainless steel probe rod driven with a hydraulic rig mounted on a vehicle. In paved locations, an access hole will be cut through the pavement prior to driving soil gas probes. In areas where vehicle access is not possible, the insertion of the soil gas probes by hand will be attempted. The probe is a hollow steel rod with a retractable tip allowing for the soil vapor entry into the tip. The samples will be recovered with a vacuum gas sampling system connected by vacuum hose directly through the probe to the sampling tip. The sample is to be collected with a gas-tight syringe and injected directly to the gas chromatograph (GC). Alternative soil gas techniques, such as passive collection methods, may be utilized if site conditions warrant it. Detection limits for soil gas analysis are specified in Table 5.3.

6.4.3 Surficial Soil Sampling Procedure

Surficial soil sampling for radionuclide and metal analysis will be conducted in accordance with SOP GT.8 using two methods depending on the presence of pavement or concrete. The Rocky Flats sampler (jig and scoop RFP method) will be used to collect surficial soils for radionuclide analysis at OU 13 IHSSs that are not covered by asphalt or concrete. This method uses a one square meter template that locates five subsamples at each sample location which is composited for analysis. (Details of this method can be found in Technical Memorandum No. 5 to the Phase III Work Plan for OU 1.) At survey points covered with pavement, a single 0- to 2-in grab will be collected after the pavement has been cored, preferably with a plug-type sampler. An additional sample below the surface of the next obvious soil horizon (preparation/roadbase horizon) or four inches below the bottom surface of the pavement will also be taken. An SOP is being developed to describe sampling for radionuclides and other parameters from beneath paved areas, and will be submitted to the regulatory agencies for approval prior to the initiation of sampling.

The samples will be analyzed on site with the HPGe detector for radionuclides. Surface samples representing a range of radionuclide concentrations will be surveyed with the detector and sent to

an offsite laboratory for radionuclide analysis and verification. Surficial soil samples from selected IHSSs will also be submitted to an offsite laboratory for determination of TAL or specific metals.

6.4.3.1 Surficial Soils Sampling - Vertical Profiles

Vertical soils profiles are required to help in the interpretation of HPGe data. At least two locations are selected from each IHSS group; one from a location showing little or no radioactivity, and the other from an area of the highest measurement of radioactivity.

The soil profiles themselves are taken from the six inches of soil. Separate grab samples are taken with a steel scoop at the 0-2" interval, the 2"-4" interval, and the 4"-6" interval.

These samples are analyzed by both radiochemical analysis and laboratory HPGe. The SOP for vertical profiling is being revised and will be submitted to the regulatory agencies for review before it is used in the field.

6.4.4 Borehole Drilling and Soil Sampling Procedures

Borings will be drilled to determine the geotechnical characteristics of the soil, to further investigate trends identified in screening tasks, to collect samples for physical and chemical analysis, and to install monitoring wells. Before any boreholes are drilled, utilities will be located and the drill site will be cleared in accordance with SOP GT.10.

Borings drilled for the purpose of documenting soil contamination will be drilled to the water table or six feet below the alluvial-bedrock contact, whichever is encountered first. Drilling the six-foot bedrock interval will allow a complete sample representative of bedrock conditions to be collected and analyzed. If sandstone is encountered in the six foot interval, the borehole will be continued through the sandstone until at least six feet of claystone is encountered. In monitoring well borings, soils collected from beneath the water table will not be submitted for chemical analysis, and borings will be advanced only three feet below the bedrock contact.

Hollow-stem auger drilling will be conducted in accordance with SOP GT.2, except where material is impenetrable with this method. If augering is ineffective, rotary drilling will be used in accordance with SOP GT.4. Rotary drilling will only be used in situations where material is impenetrable, with hollow-stem augering the method of choice. At locations with shallow borings where the drill rig cannot enter, hand augers will be used in accordance with guidelines in SOP GT.2 and GT.8.

All drill cuttings and soil samples will be surveyed for radionuclides and organic vapors in accordance with SOP FO.15, Use of Photoionizing and Flame Ionizing Detectors, and SOP FO.6, Field Radiological Measurements. Investigation-derived wastes, such as drill cuttings and residual samples, will be handled according to guidelines in SOP FO.8 and FO.9.

All equipment must be decontaminated before and after drilling and sampling takes place in accordance with the procedures outlined in the SOP FO.3 and FO.4. Decontamination water will be handled according to guidelines in SOP FO.7.

All of the borings not identified to be completed as monitoring wells will be grouted and abandoned immediately after drilling in accordance with procedures outlined in SOP GT.5. Procedures specified in this SOP are designed to prevent vertical migration of contaminants after abandonment.

Soil and bedrock samples will be collected during drilling for visual logging in accordance with SOP GT.1 and for chemical and physical analysis in accordance with SOPs GT.2 and FO.13. The soil and bedrock samples will be collected using a hollow-stem auger with a continuous-core sampler. Continuous core will be collected for geologic descriptions for the entire borehole depth. From this core, discrete, 2-ft samples will be submitted for laboratory volatile organic analyses (VOA) as shown in Figure 6-11. In addition, a discrete VOA sample will be collected at the water table and at the alluvium-bedrock contact. VOA soil samples should be collected in core liners that are capped and sealed upon recovery. In addition to the VOA samples, linear depth composite samples from the core will be submitted to the laboratory for analysis of the remaining chemical parameters from every consecutive 6 ft interval to the water table.

Soil samples for geotechnical analysis require a minimum amount of disturbance and will be collected in thin-walled metal tubes. The thin-walled metal tube will be driven into the undisturbed soils in advance of the hollow-stem auger, removed, and the tube sealed for transport to the laboratory. Any changes to these geotechnical sampling procedures will be the subject of a document change notice.

6.4.5 Asphalt/Concrete Sampling Procedure

Asphalt and/or concrete samples will be collected at some IHSSs where the potential exists that releases resulted in contamination of the asphalt/concrete. These samples will consist of two small-diameter (approximately 1-inch) core plugs. The core plugs will be collected using a hand core drill. The samples will be handled in accordance with SOP FO.13 and will be analyzed for gamma-emitting radionuclides with a laboratory HPGe. The SOP for the laboratory HPGe is currently under development and will be submitted to the agencies for approval prior to its use.

6.4.6 Installing and Sampling of Groundwater Monitoring Wells

All monitoring wells will be constructed with materials specified in SOP GW.6. A hollow-stem auger with an inner diameter a minimum of 4 inches larger than the well casing outer diameter will be used to drill the monitoring wells so as to produce a minimum annular space of 2 inches. Well construction techniques will follow procedures outlined in SOP GT.6. Investigation-derived wastes such as cuttings and residual samples will be handled in accordance with guidelines outlined in SOP FO.8.

Well construction techniques for all monitoring wells will follow procedures contained in SOP GT.6. Monitoring wells in high-traffic paved areas will be completed flush with the pavement. Wells in areas not exposed to vehicular traffic will be protected by the placement of steel posts around the monitoring wells, as described in SOP GT.6. Pressure grouting procedures will follow guidelines outlined in SOP GT.3. Additional equipment and materials that may be needed for

monitoring well installation are listed in SOP GT.6, Section 5.1; other related SOPs are cross-referenced in Section 4.2 of SOP GT.6.
The wells will be developed no sooner than 48 hours and no longer than two weeks after completion and will not be sampled until at least two weeks after development. Water levels will be measured in all wells and recorded as outlined in SOP GW.1 and the appropriately cross-referenced SOP listed in Section 4.2 of SOP GW.1. After the water levels reach static conditions, the wells will be developed utilizing low-energy methods, such as an internal pump or bottom discharging bailer. Well development will follow procedures outlined in SOP GW.2.

Prior to groundwater sampling, three to five casing volumes of water will be purged from the well by either bailing or pumping. Purging procedures will follow those contained in SOP GW.6. Field parameters (pH, specific conductance, temperature) will be measured after every half casing volume is removed as described in SOP GW.6.

Groundwater samples will be collected in a manner that will minimize the amount of agitation or limit the exposure of the sample to the atmosphere. Groundwater sampling will be by bailing or the use of bladder or peristaltic pump. Samples will be collected, handled, and screened in accordance with SOP GW.6 and all related SOP.

All development and purge water will be handled in accordance with guidelines outlined in SOP FO.8. Equipment needed for groundwater sampling is listed in SOP GW.6.

Field parameters will be measured when each groundwater sample is collected. Specific conductance, pH, and temperature will be measured when groundwater samples are collected in accordance with SOP GW.6. Water level measurements will be conducted in accordance with SOP GW.1 and the appropriately cross-referenced SOP listed in Section 4.2 of this SOP GW.1.

Collection of groundwater samples with the Hydropunch® is not addressed by a current SOP. One will be developed prior to initiating sampling activities. Because a relatively large volume of sample is required for the analyses specified in Section 6.3.3, the Hydropunch II®, or equivalent, sampler will be used. The Hydropunch II® will be lowered inside a hollow stem auger and then

pushed or driven to a depth of at least 5 feet below the water table, if possible. Once the sampler is in place, the body of the sampler is pulled back allowing groundwater to flow into the tool. A small diameter bailer is then inserted into the tool for collection of a sample. Once sampling is complete, the tool can be pulled from the ground; however, a sacrificial screen remains in place.

6.4.7 Sump Sampling Procedure

Standing water in the sump located within IHSS 171 will be sampled for the parameters specified in Section 6.3.1.10. The water in the sump will be collected in accordance with Section 5.3.3 of SOP SW.3. The water will also be analyzed in the field for temperature, pH, and specific conductance.

6.4.8 Surveying of Sample Locations

The locations of all radiometric survey points, soil gas survey points, borings, and surface sampling points will be determined prior to sampling or drilling. After sampling, drilling, or well installation, locations will be surveyed using standard land surveying techniques described in SOP GT.17. Horizontal accuracy will be $\pm$ 0.5 ft for surficial soil samples, soil gas survey points, and borings and $\pm$ 0.1 ft for temporary well point locations and wells. Three elevations will be determined for each well: ground surface, top of well casing, and top of surface casing.

6.5 SAMPLE ANALYSIS

6.5.1 Soil Gas Analysis

Soil gas samples will be analyzed for the parameters specified for each IHSS in Sections 6.3.1.1 to 6.3.1.11. The SOPs applicable to the analysis of soil gas samples are specified in Table 6.3. Detection limits for these analyses are specified in Table 5.3.

6.5.2 Borehole Samples

6.5.2.1 Chemical Analysis

Borehole samples will be collected for chemical analysis from surficial materials and weathered bedrock, as discussed in Sections 6.3.2 and 6.3.3. Section 6.3.2 and Table 6.4 designate borehole samples for analysis and provide the chemical parameters that the samples will be analyzed for. The detection limits for these analyses are specified in Table 5.3.

6.5.2.2 Physical Analysis

Physical analysis of five samples of alluvium and five samples of bedrock from random boreholes throughout OU 13 will be performed. Physical analysis on alluvium and bedrock samples will consist of classification (ASTM [American Society for Testing and Materials] D2488), moisture content (ASTM D2216), and dry density for intact samples (ASTM D2216). Laboratory classification tests will consist of grain size distribution (ASTM D422) (including hydrometer analysis) and Atterberg limits (ASTM D4318).

6.5.3 Groundwater Samples

Groundwater samples will be collected from existing wells and piezometers identified in Sections 6.3.1.1 to 6.3.1.11 and from new and existing wells and piezometers as identified in Section 6.3.3. Samples will be measured in the field for pH, specific conductance, and temperature in accordance with the procedure specified in Table 6.3. Table 6.4 lists the analytical parameters for groundwater samples for the Stage 1 investigation. Subsequent sampling iterations may require analyses of a less extensive suite of analytes as specified in Section 6.3.3. Laboratory analyses for dissolved metals will be performed on samples filtered in the field using a 0.45 μm cellulose acetate filter prior to sample preservation.

6.5.4 Sample Containers and Preservation

The type of analysis and media to be sampled dictates the sample container volume and material requirements, preservation techniques, and holding times. Information relating to sample containers and preservatives is provided in SOP FO.13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples. The parameters specific to OU 13 with the corresponding containers, preservative, and holding time are listed in Table 6.5.

6.5.5 Sample Handling and Documentation

Sample control and documentation is necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include logbooks, data collection forms, sample labels or tags, chain-of-custody forms, photographs, and analytical records and reports. Specific guidance describing container labeling, decontamination, field packaging, chain-of-custody records, field data documentation, packaging and shipping is provided in SOP FO.13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples.

Field data and reporting requirements are discussed in detail in SOP FO.14 Field Data Management. In general the following procedures must be followed:

- Collection of data on pre-printed forms;
- Preliminary verification of the data;
- Technical verification by a qualified verifier;
- Data input into the Rocky Flats Environmental Data System (RFEDS);
- Verification of input;
- Archive and filing of data;
- Security of database and computers;
- Documentation of implementation of the referenced SOP; and
- Use of data management forms.

TABLE 6.6
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES FOR SOIL AND WATER SAMPLES

SOIL SAMPLES			
Parameter	**Container**	**Preservative**	**Holding Time**
TAL Metals	1 x 250 ml wide-mouth glass jar	None	180 days**
TCL Volatiles	2 x 125 ml wide-mouth glass vials	Cool, 4 degrees C	7 days
TCL Semivolatiles	1 x 250 ml wide-mouth glass jar	Cool, 4 degrees C	7 days until extraction 40 days after extraction
Radionuclides *	1 x 11 wide-mouth glass jar	None	None
WATER SAMPLES			
Parameter	**Container**	**Preservative**	**Holding Time**
TAL Metals	1 x 11 polyethylene bottle	Nitric acid pH<2; Cool, 4 degrees C	180 days**
TCL Volatiles	2 x 40 ml VOA vials with teflon-lined septum lids	Cool, 4 degrees C	7 days
TCL Semivolatiles	1 x 41 amber glass bottle	Cool, 4 degrees C	7 days until extraction 40 days after extraction
Radionuclides	1 x 12.01 polythylene bottle	Nitric acid pH<2	180 days
Anions	1 x 11 polyethylene bottle	Cool, 4 degrees C	28 days
Nitrate/Nitrite	1 x 21 polythylene bottle	Sulfuric acid pH<2 Cool, 4 degrees C	28 days
Sulfate	125 ml HPDE bottle	Cool, 4 degrees C	28 days
pH, Temperature, andspecific	In situ, beaker or bucket	None	Analyze immediately

* This container is suitable for asphalt samples.

** Holding time for mercury is 28 days.

6.5.6 Sample Designation

The Rocky Flats Environmental Data System (RFEDS) requires all sample designations to be consistent. Each sample designation will contain a nine-character sample number consisting of a two-letter prefix that relates to the type of sample collected (e.g., "SB" for soil borings, "SS" for surface soils), a unique five-digit number, and a two-letter suffix identifying the contractor. One sample number will be required for each sample generated, including quality control samples. Using this system, 99,999 unique sample numbers are available for each sample media per contractor. Boring numbers will be developed independently of the sample number for a given boring; however, the boring number and sample number are linked so that data for particular samples can be related to the boring from which the sample was taken. These sample numbering procedures are consistent with the RFP sitewide QAPjP.

6.6 FIELD QC PROCEDURES

Sample duplicates, field preservation blanks, and equipment rinsate blanks will be prepared. Trip blanks will be obtained from the laboratory. The analytical results obtained for these samples will be used by the EMD project manager to assess the quality of the field sampling effort. The types of field QC samples to be collected and their application are discussed below. The frequency with which QC samples will be collected and analyzed is provided in Table 6.6.

Duplicate samples will be collected by the sampling team for use as a relative measure of the precision of the sample collection process. These samples will be collected at the same time, using the same procedures and equipment, and placed in the same types of containers as required for the samples. They will also be preserved in the same manner and submitted for the same analyses as required for the samples.

Field blanks of distilled water, preserved according to the preservation requirements (Section 6.5.4), will be prepared by the sampling team and will be used to provide any indication of any contamination introduced during field preparation. As indicated in Table 6.6, these QC samples are applicable only to samples requiring chemical preservation.

Equipment (rinsate) blanks will be collected from final decontamination rinsate to evaluate the success of the field sampling team's decontamination efforts on non-dedicated sampling equipment. Equipment blanks are obtained by rinsing cleaned equipment with distilled water prior to sample collection. The rinsate is collected and placed in the appropriate sample containers. Equipment blanks are applicable to all analyses for water and soil samples and for organics analysis of soil gas samples, as indicated in Table 6.6. Equipment blanks for soil gas sampling will consist of blanks taken and analyzed to check background contamination in the sampling system and cartridges (see SOP FO.09).

Trip blanks consisting of ASTM Type II laboratory reagent water will be prepared by the laboratory technician and will accompany each shipment of samples for VOCS analysis. Trip blanks will be stored with the group of samples with which they are associated. Analysis of the trip blank will indicate migration of VOCs or any problems associated with sample shipment, handling, or storage. Trip blanks for soil gas analysis will consist of an unused sample cartridge transported into the field with the sampling equipment. The trip blank cartridge will be handled in the same manner as a sample, but a sample will not be collected through this cartridge.

TABLE 6.7
FIELD QC SAMPLE FREQUENCY

Sample Type	Type of Analysis	Media		
		Solids	Liquids	Soil Gas
Duplicates	Organics	1/10	1/10	1/10
	Inorganics	1/10	1/10	N/A
	Radionuclides	1/10	1/10	N/A
Field Preservation Blanks	Organics	N/A	N/A	N/A
	Inorganics	N/A	1/20	N/A
	Radionuclides	N/A	1/20	N/A
Equipment Blanks	Organics	1/20*	1/20*	IPD
	Inorganics	1/20*	1/20*	N/A
	Radionuclides	1/20*	1/20*	N/A
Trip Blanks	Organics	NR	1/20	1/20
	Inorganics	NR	NR	N/A
	Radionuclides	NR	NR	N/A

NA = Not Applicable
NR = Not Required
1/10 = 1 QC sample per 10 samples collected
1/20 = 1 QC sample per 20 samples collected
1/20* = 1 QC sample per 20 samples collected or 1 QC sample per day whichever is more frequent
1PD = 1 QC sample per day and prior to reuse of recleaned samplilng equipment

OU136-12.DWG

LEGEND

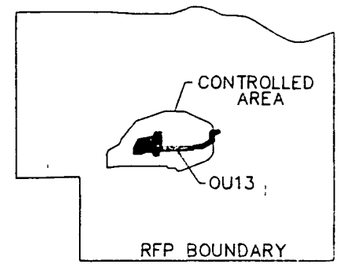
- ⊗ — PRELIMINARY LOCATION OF ALLUVIAL GROUNDWATER MONITORING WELL TO BE INSTALLED IN STAGE 3
- 4486 ○ — EXISTING WELL OR PIEZOMETER THAT MAY BE SAMPLED DURING STAGE 3
- ▬▬ — OPERABLE UNIT 13 BOUNDARY
- 191 ▯ — INDIVIDUAL HAZARDOUS SUBSTANCE SITES

NOTE: THE FINAL NUMBER AND LOCATION OF NEW WELLS TO BE INSTALLED OR EXISTING WELLS AND PIEZOMETERS TO BE SAMPLED WILL BE ESTABLISHED AFTER STAGE 2 HAS BEEN COMPLETED

-N-

SCALE

0 200 400



U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden Colorado

OPERABLE UNIT NO. 13
PHASE I RFI/RI WORK PLAN

FIGURE 6-12

STAGE 3
PRELIMINARY LOCATIONS OF GROUNDWATER MONITORING WELLS/PIEZOMETERS

P114589
P114489
P119389
P115089
P114989
P114889
P114789
117.1
186
P214689
128
171
158
117.2
134
P115189
P115489
P115589
P115689
P214089
P215789
117.3
191
4486
190
6186
148
157.1
152
P414189
P418289
P313489
P320089
P416189
P416289
P419689
P313589

OU136-2.DWG

P114589

P114489

P119389

P115089

P114989
e,f,k

P114889
e,f,k

117.1

186

P114789
e,f,k,l

a,b,j,l
P214689

128

171

158

117.2

134

P115189

P115489
f,g

P115589
a,b,g,i,j

P115689
b,g,i,j

P215789
b,j

P214089

117.3

191

4486
d,g,i

190

152

157.1

6186

P415989
d,g

148

P414189
c,h

P418289
c,h

P313489

P320089

P416189
d,g

P416289

P419689

P313589

LEGEND

INDIVIDUAL HAZARDOUS SUBSTANCE SITES TO WHICH GROUNDWATER DATA MAY BE APPLICABLE

a	117.1	g	148
b	117.2	h	152
c	117.3	i	157.1
d	122	j	158
e	128	k	171
f	134	l	186

191 — INDIVIDUAL HAZARDOUS SUBSTANCE SITES

OPERABLE UNIT 13

4486 — EXISTING WELL OR PIEZOMETER TO BE SAMPLED DURING STAGE 1

-N-

SCALE

0 200 400

CONTROLLED AREA

OU13

RFP BOUNDARY

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden Colorado

OPERABLE UNIT NO. 13
PHASE I RFI/RI WORK PLAN

FIGURE 6-2

STAGE 1
EXISTING GROUNDWATER MONITORING WELLS AND PIEZOMETERS TO BE SAMPLED